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CLARK FORK SUPERFUND DATA SYSTEM
MASTER PROJECT PLAN
for the
GEOGRAPHIC INFORMATION SYSTEM
and
DATA MANAGEMENT SYSTEM

DRAFT

July 5, 1989

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Section I
Program

EXECUTIVE SUMMARY

In 1986, the U.S. Environmental Protection Agency (EPA), Region 8-Helena Office determined that the development and use of a comprehensive data management system would be valuable in achieving the goals of the upper Clark Fork River Superfund project. There are four major Superfund sites along the upper Clark Fork River, and their combined geographical area comprises one of the largest Superfund sites in the United States. Since the sites are interrelated, all Superfund activities within the upper Clark Fork Basin must be coordinated to maintain consistency in enforcement strategies, community relations, sequencing of remedial actions, risk assessment, and modeling of potential environmental impacts.

To confront the extraordinary challenges in coordination and data management, an integrated information management system was essential. Such a system would be needed to organize and manage the volumes of tabular data generated throughout the multiple investigations. In addition, given the interconnections among the sites and massive spatial coverages involved, a geographic information system (GIS) was needed to complement the central data system. A GIS is the only computerized tool powerful and flexible enough to support the analyses of various scenarios developed to meet planning, remedial, oversight, and enforcement objectives. The GIS would be instrumental in conducting the analyses in a timely and cost effective manner.

Thus, in early 1987, EPA officials formalized an agreement with the Montana Department of Health and Environmental Sciences (MDHES) to develop and implement an integrated Data Management System (DMS). Later in 1987, the MDHES selected the Montana State Library and its Natural Resource Information System (NRIS) to develop and implement a GIS. Procedures were initiated requiring all personnel -- federal, state, contractor -- working on the four upper Clark Fork sites to use the multi-purpose Clark Fork Data System.

Throughout 1987 and 1988, a great deal of progress was made in developing the Data System, including its GIS component. Hardware and software to support minimum configurations of both the DMS and the GIS have been acquired and installed. Personnel have been recruited and hired to administer and operate the DMS and the GIS. Extensive work on computer programs to implement the Data System has been completed. Both the DMS and the GIS are operational, with several data products completed.

However, the productive use of an integrated data management system, including a GIS, depends critically on effective planning, particularly in the case of a multi-dimensional, multi-agency, multi-task endeavor, such as the Clark Fork Superfund project. This document, the *Clark Fork Data System Master Project Plan*, has been prepared to address the need for sound planning. The *Master Project Plan* provides the framework for coordinated data management activities -- to ensure that the data management needs of the Clark Fork Superfund project are fully met and system requirements to meet those needs are adequately defined for the long term. The effort to develop and implement a long-term strategy is absolutely required to effect a valuable data system, and in the larger perspective, vital to the success of the cleanup efforts.

This Executive Summary provides a brief overview of the *Master Project Plan*, describes its main sections and their purposes, and summarizes the main policies, procedures, programs, and projects presented. The plan is divided into two principle sections: the first describes the Clark Fork Data System Program and the second describes the projects to be undertaken. Chapters 1-6 represent Program considerations and guidance. Chapters 7 (Applications) and 8 (Budget Considerations) represent Project specific material which will be updated and changed by the Technical Working Group over the life of the Clark Fork Data System Project.

Four Sites, One Project

Chapter 1 presents a historical snapshot of the Clark Fork River Watershed and the events that led to its designation as a Superfund site and its ranking on the National Priority List. The four primary sites within the Clark Fork Basin are described in terms of how contamination occurred. Also described are developments at each site since the Superfund designation and the status of remedial actions undertaken.

Basically, 100 years of mining and related activities generated widespread contamination in the river basin -- in the water, in the soil, in the air, and in some cases, in the people. Heavy metals contamination is pervasive in the region, and the Clark Fork River, including its tributaries, has been the primary transportation network for the contaminants. When Congress passed the landmark Superfund legislation, the problems in the Clark Fork river came into national focus. When EPA released its 1983 list of priority sites, three separate sites within the upper Clark Fork River Basin were listed:

1) Silver Bow Creek
2) Anaconda Smelter
3) Milltown Dam

A substantial site, the city of Butte, was added in November of 1985 as an addition to the Silver Bow Creek site. The Montana Pole site was added to the list in November of 1986.

Most hazardous waste sites have a geographic size of less than 100 acres. The Clark Fork Project, with its four sites, is considerably different, encompassing several hundred square miles -- roughly a 130 mile corridor stretching from Butte to Missoula along the river's reach. Although each of the four separate sites presents a highly complex series of distinct human health and environmental problems, there are several substantive relationships between and among them. What may be proposed as a remedial option at one site may affect the other sites, and strategies to remedy the situation at one site must be developed accordingly. Thus, the cleanup efforts are considered as one, regional, integrated project.

Chapter 1 concludes with a brief summation of events that led to the decision to develop the Clark Fork Data System and describes the basic Data System model.

An Interagency Project With Many Players

Behind any information management project of this magnitude, there is always a cadre of managers, professionals, and support technicians working together. The Clark Fork Data System project is no exception; in fact, the multitude of agencies and personnel involved in this effort pushes the limits of organizational management. Chapter 2 outlines the functions, tasks, assignments, and responsibilities of the various state and federal agencies related to their involvement in the Data System. Note, however, that Chapter 2 makes no attempt to present the overall organizational structure of the entire Clark Fork Superfund project and focuses solely on the Data System activities of the project.

The principal coordinating group responsible for interagency communication and data system management is the Clark Fork Technical Working Group (TWG), formed in September, 1988. The TWG includes EPA, MDHES, Environmental Monitoring Systems Laboratory-Las Vegas (EMSL-LV), and Bureau of Reclamation personnel and is chaired by a State Library representative. The TWG plans and manages the detailed operational aspects of the Data System; the development of this comprehensive Project Plan is the product of the Group's efforts.

Monitoring the work of the TWG is the Clark Fork Steering Committee, established to provide policy and oversight of the cooperative agreement which provides for the development and

use of the Data System. With members from EPA-Region VIII in Denver and Montana, MDHES, and the MSL, the Steering Committee provides the coordination at higher levels of the agencies' operations. Site officers and other personnel from the MDHES and the Montana EPA, GIS staff at the State Library, and scientists from the EMSL-LV are also vitally involved in the data system project. Their roles and responsibilities conclude Chapter 2.

Tools of the Trade: Hardware, Software, Personnel

There are four key elements to an information management system: hardware, software, people, and data. Chapter 3 describes the first three as applied to the Clark Fork Data System. The hardware configuration for the central Data Management System at MDHES is a PC environment using a standard data management software, Knowledgeman 2. The GIS at the State Library relies on a PRIME minicomputer and assorted peripherals, and utilizes two leading GIS software products, ARC/INFO and ERDAS. Future plans call for full integration between the two components of the Data System via modem, with all personnel networked as needed.

Full time staff committed to the project is modest at this time, with one full time administrator assigned to the Data Management System and two full time professionals responsible for the GIS implementation. Various other staff are also assigned responsibilities on the Data System in a part-time capacity. Plans call for some staff expansion in the next two years to accommodate the increasing needs of the site officers and other project personnel, particularly with the proposed GIS projects as site work advances to decision and action phases.

Quality Control

No data system is worth the time, effort and resources committed to it unless adequate provisions are made to ensure that products generated from it are accurate and able to support the purposes for which they are intended. For the Clark Fork Data System, quality control is imperative. In the context of the delicate negotiations associated with cleanup activities, the Data System and more precisely the data-based products it generates must be sound and above reproach.

The Data Administration Plan, presented in Chapter 4, sets forth procedures for management of data received from all parties associated with the cleanup effort -- EPA, Potential Responsible Partys (PRPs), MDHES, contractors, and other data providers. The procedures and documentation, as described in this Data Administration Plan, are used to differentiate between data on the basis of quality. The Data Administration Plan specifies data development needs for the Superfund project, thus providing a framework for the development of data management objectives and practices. The Data Administration Plan also describes the flow of data from the source into the Clark Fork Data system, between the components of the Data System, to and from external models and analysis systems and from the Data System to end users.

Although each section of this *Master Project Plan* has an important purpose, Chapter 4, along with Chapter 7, are perhaps the most substantive sections in terms of the actual implementation of the Data System. These two Chapters lay out policies, procedures, and specific activities of the Data System.

Access Guidelines

One of the most delicate issues to address when designing and implementing an integrated Data System is access: Who should have access? Who should not? On the surface, the issue seems simple: If the system is designed to be integrated, everyone associated with the project should have access. However, in the context of quality control, available resources,

enforcement issues, confidentiality, and response demands, user access becomes a complex question.

Chapter 5 describes the access guidelines that have been developed by a subcommittee of the Technical Working Group. The guidelines address who should have direct access (i.e., ability to add, delete, or change data) versus indirect access (i.e., ability to view and down-load data), outline the access priorities, and establish a process by which data requests and access will be handled. Essentially, the guidelines call upon the Data Management System Manager and the GIS Officer, in consultation with the Clark Fork Coordinator, to manage the process and to establish a system of user accounts to document access use, needs, and demands of the Data System. All parties associated with the project--federal, state, contractor, and PRPs--may have access to data and services.

User Support and Training

Chapter 6 discusses the provision of training and support to users. The central Data Management System housed at MDHES has been developed with a user-friendly interface which provides for effective use of the system by persons with limited training. Query function and report formats allow for easy operation of the System. The GIS, on the other hand, is more complex and requires specialized training. Chapter 6 describes the courses and training available, and clarifies how user support is provided to novice or new users.

A main concept of user support is the "service bureau" orientation of the Data System managers. For project personnel without sufficient time to learn the various protocols, etc. of the System, personnel are available to assist with queries and various data needs.

GIS Applications and Data Acquisition Plan

Given the vast geographical area of the Clark Fork project and the many interconnections among the four sites, a GIS is a valuable tool for assisting project managers with remedial investigations, feasibility studies, and other data management activities. In developing a process to use a GIS, two critical issues emerge: 1) identifying and setting suitable project priorities, and 2) identifying and obtaining the data needed to conduct the projects. Chapter 7 specifies the projects and applications proposed for the GIS, based on the results of a User Survey conducted among all Clark Fork Superfund managers and site officers. Chapter 7 also details a set of guidelines to establish priorities for the projects, and presents a proposed ranking of GIS applications based on preliminary evaluations conducted by the Technical Working Group using the priority guidelines.

The descriptions of the GIS applications are divided into six sections, generally matching the four sites, with Silver Bow Creek and the Butte Addition split up, and a sixth section on Basin-wide applications. In each section, the prospective applications are discussed, with particular emphasis on identifying existing data to support the applications and data to be acquired. Also discussed are the objective of each application, the products to be developed, the software needed, and possible applications that fall outside the term of this two-year plan.

Chapter 7 provides a blueprint for immediate action. Also provided is a key decision-making tool, particularly as the use of the GIS increases over time. As the projects mature and as more data coverages become available, the GIS will become increasingly useful. Consequently, there will be increasing competition for access; prioritizing projects will become more difficult. Establishing priority guidelines now help in making important priority decisions in the future.

Resources Required

Chapters 1 through 7 of the *Master Project Plan* will form the basis for the scope of work to be negotiated and detailed in an amended Cooperative Agreement between the EPA and the

MDHES (and its contractors) regarding the Clark Fork Data System. Tasks, timelines, deliverables, and related responsibilities will be derived from this *Plan.* Chapter 8 presents the detailed budgets, with line item justifications, which will also be incorporated into the Cooperative Agreement application. Described are the level and projected cost of personnel services needed to get the job done, along with cost estimates of the equipment, supplies, and related materials and services needed to support the personnel working on the Clark Fork Data System.

The budget estimates have been prepared in consideration of the objectives and activities outlined in the *Master Project Plan*, coupled with a careful examination of Data System project costs over the term of the first Cooperative Agreement, covering Fiscal Years 1988 and 1989. The new budgets are presented for each of two years: Fiscal Year 1990, for the period October 1, 1989 to September 30, 1990, and Fiscal Year 1991, covering October 1, 1990 through September 30, 1991. The budgets are further broken down according to System component, with separate figures for the Data Management System housed at MDHES and for the GIS at the Montana State Library. Cost estimates are based on the best available figures as of April 14, 1989.

With regard to the GIS at the State Library, the existing Cooperative Agreement specifies that the GIS must be used exclusively for the Clark Fork Superfund project until such time as that project is fully and effectively supported. It also specifies that at some future point, in the event that Superfund work did not demand 100 percent of the system capabilities, the State Library would be allowed to offer GIS services to other Montana state agencies, thus effecting full utilization of the System. It is anticipated that this point of "shared use" will be reached during the term of the amended Cooperative Agreement. Therefore, the State Library has prepared a discussion document, entitled the *Montana State Library GIS Cost-sharing Plan*, attached as an addendum to the *Master Project Plan.*

The *GIS Proposed Cost-sharing Plan* is designed to guide and focus the discussion regarding the long-term disposition and use of the GIS, and to provide a communication tool through which all parties involved in this interagency project can provide input into and direct a "shared use" strategy for the GIS. The *GIS Proposed Cost-sharing Plan* outlines a strategy to meet the GIS needs of all staff working on the Clark Fork Superfund sites in the most efficient and cost-effective manner possible. At the same time, it presents a plan to identify and engage non-Clark Fork Superfund users of the GIS in a resource-sharing and cost-sharing strategy, without limiting access and priority of Clark Fork Superfund GIS users. Costs for non-Superfund use would be carefully documented so that Superfund costs will be properly accounted for.

Appendices: Supporting Documents

The development of the Clark Fork Data System has been underway for almost two years. During this period, several documents have been produced that chronicle the work completed. Contracts, reports, agreements, work plans, work orders, surveys, data dictionaries, etc. There are 17 Appendices attached to the *Master Project Plan* that provide background material pertinent to understanding and evaluating the information contained in the *Project Plan.*

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PREFACE

The *Clark Fork Superfund Data System Master Project Plan* was prepared as a planning document and at the request of Region VIII of the Environmental Protection Agency to support the Clark Fork Cooperative Agreement. This document was produced by the Clark Fork Technical Working Group. The function of the Clark Fork Data System is to support the planning and remedial efforts of state and federal project managers for the four Superfund National Priority List (NPL) sites in the Upper Clark Fork Basin. The **Clark Fork Data System** is comprised of two components:

- the **Clark Fork Data Management System**, managed by the Montana Department of Health and Environmental Sciences; and,

- the **Clark Fork Geographic Information System**, managed by the Montana State Library's Natural Resource Information System.

The plan is divided into Program and Project specific sections. Chapters 1-6 represent Program considerations and guidance. Chapters 7 (*Applications*) and 8 (*Budget Considerations*) represent Project specific, dynamic material which will be evaluated and updated by the Technical Working Group over the life of the Clark Fork Data System Project.

The Clark Fork Data System involves state, federal, and private sector organizations. These entities and their organizational relationships are depicted in Figure 1. All of these organizations were represented in the preparation of this document. Agencies and personnel responsible for the production of this document include:

Montana State Library Natural Resource Information System
Allan Cox, GIS Officer
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Mason Hewitt, Environmental Scientist, (EPA)
David James, Senior Scientist, (Lockheed)

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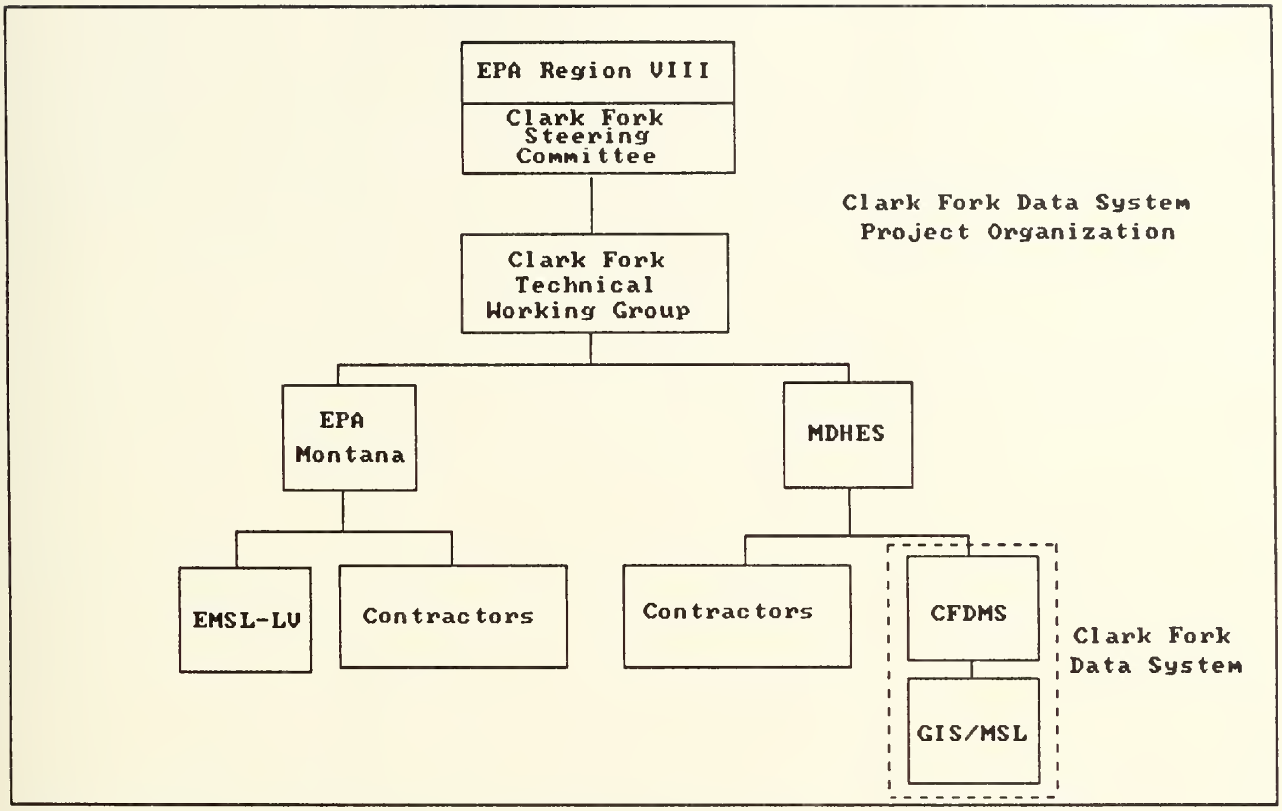
EPA Region VIII
Clark Fork Steering Committee
Clark Fork Data System Project Organization
Clark Fork Technical Working Group
EPA Montana
MDHES
EMSL-LV
Contractors
Contractors
CFDMS
GIS/MSL
Clark Fork Data System

Figure 1 Clark Fork Data System Organizational Structure

Many acronyms appear in the text to simplify reading and referencing. Explanations of each acronym are given in the text and in *Appendix B - Project Acronyms.*

Disclaimer

The mention or use of trade names, computer hardware, computer software, or commercial products does not constitute recommendation for use or endorsement.

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Other staff at the Montana State Library who contributed to the production of this document include Gerry Daumiller, Programmer/Analyst for the Clark Fork GIS, Val Jaffe, intern for the Clark Fork GIS, and Pam Smith and Dianne Capron, Data Technicians with the Natural Resource Information System.

All maps included in this document were produced by the Clark Fork GIS Project at the Montana State Library.

CHAPTER 1 - BACKGROUND

The Clark Fork River is located in west central Montana. Mining has been the primary industry for the past 100 years within the upper Clark Fork River watershed. Widespread contamination has occurred as a result of these mining and related activities. While this contamination has been recognized historically, only recently has it been quantified to the extent necessary to begin to address specific response actions. Four sites in the area (see Figure 2) are currently on the National Priority List (NPL).

1.1 SILVER BOW CREEK/BUTTE ADDITION

Following the discovery of gold in 1864, the Butte area became an internationally recognized mining center with over 300 combined copper and silver mines, 9 silver mines, and 8 smelters in operation during 1884. In 1955, excavation of the Berkeley Pit began and mining continued until 1977. Silver Bow Creek has historically received discharge from mining, smelting, wood treating, and other industrial sources for over 100 years.

The Silver Bow Creek site was designated a Superfund site in September 1983. The original site encompassed the floodplain of Silver Bow Creek from Butte downstream to the Warm Springs Ponds. Remedial investigations were initiated within this area during 1985. In November 1985, the boundaries of the site were expanded to include the Butte area. Downstream portions of the Clark Fork River floodplain from Warm Springs Ponds to Milltown Reservoir were identified as an expanded study area.

The Silver Bow Creek site extends 130 miles from the Yankee Doodle Tailings Ponds (just below the Continental Divide) to the Milltown Reservoir. Included in the site are the cities of Walkerville, Centerville, and Butte, and the 100 year flood plains of Silver Bow Creek and the Clark Fork River. Silver Bow Creek has been the primary recipient of the mining, milling, concentrating, and smelting wastes for approximately 100 years. Silver Bow Creek also served as Butte's industrial sewer. The remedial investigation process is under way at the site through a Cooperative Agreement with the State of Montana.

Widespread heavy metals contamination of surface and ground water, and fluvial and impounded tailings are major areas of concern. Other concerns include re-suspension of heavy metals laden sediment, free flowing mercury and mercury vapors from historic amalgam operations, and organic contamination from local timber treatment.

Today mining, milling, and smelting wastes exist as sources of soil, water, and air contamination throughout the Butte area. Contaminated surface water runoff from the Butte area discharges directly to Silver Bow Creek. In addition, underground mines in the area are filling and generating acid water as water levels rise. During active mining, these mines were de-watered by a network of pumps with some water being recycled and some being discharged to Silver Bow Creek. It is estimated that over 3,500 miles of underground mine workings are interconnected with the Berkeley Pit. These mines contain approximately 11.2 billion gallons of acid mine water. Initial investigations suggest that within eight years at the earliest, water in the Berkeley Pit may rise to a level where acid mine drainage could contact the bedrock/alluvium interface with the possibility for contamination of Silver Bow Creek.

In addition to contaminants from the Butte area, the Montana Pole and Rocker wood treating sites contribute to the contaminant load of Silver Bow Creek. Continuous deposits of metals-laden sediments and tailings lie within the floodplain and contaminate surface and ground water along Silver Bow Creek and the Upper Clark Fork River. The Anaconda Smelter site also has contributed contamination to the Clark Fork River.

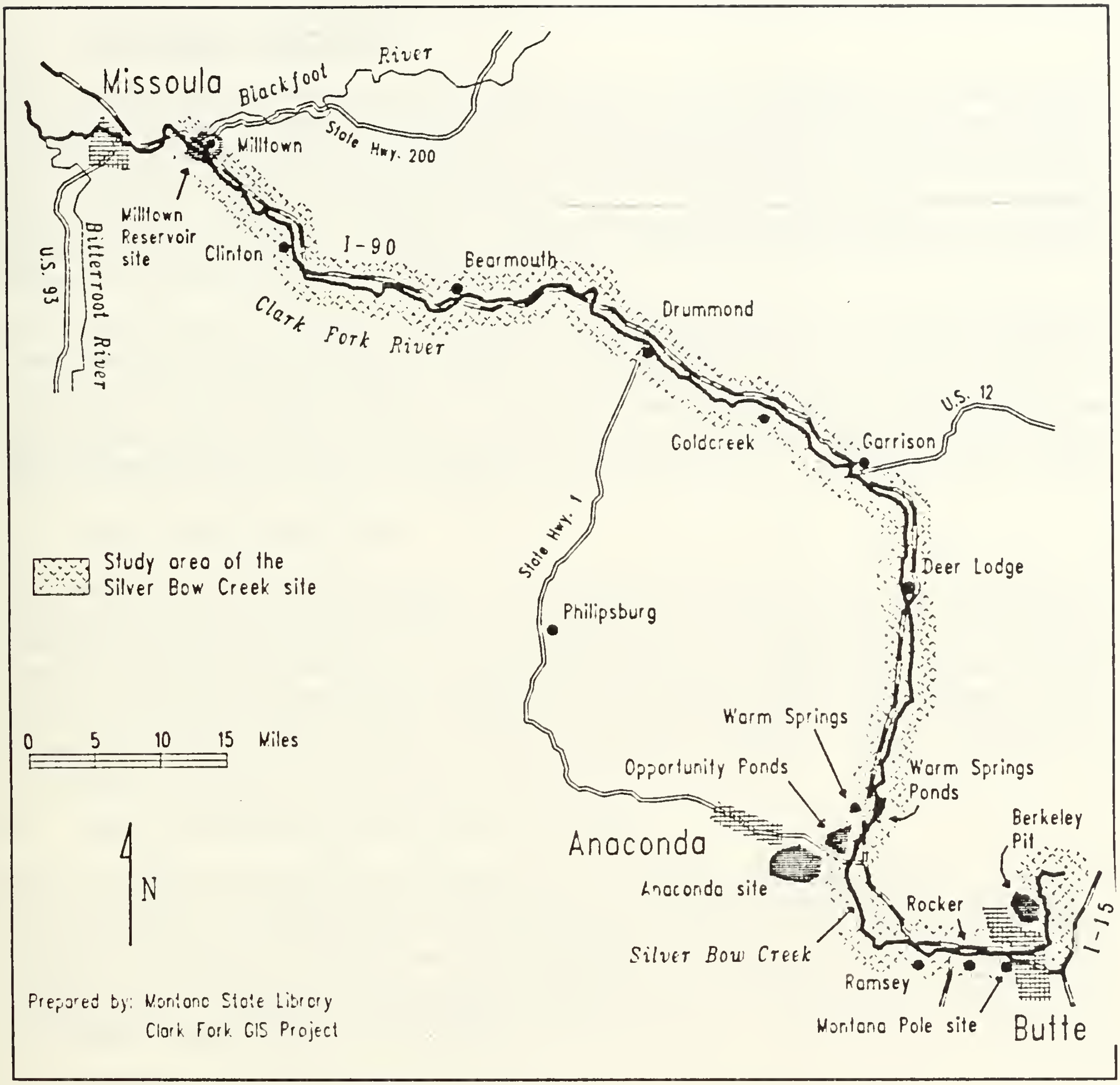


Figure 2: Map of Upper Clark Fork NPL Sites

1.2 MONTANA POLE

The Montana Pole site is located in the western part of Butte adjacent to Silver Bow Creek. The Montana Pole Treating Company operated for about 30 years using pentachlorophenol mixed with diesel fuel to treat poles used for various purposes.

Oil was found leaching into Silver Bow Creek at a point directly below the plant site. A removal action under Superfund began in the summer of 1985 to mitigate the immediate threat to human health caused by past pole treating operations. Under the removal action, contaminated ground water is being pumped and separated from the oil, then re-injected. Visibly contaminated soil has been removed and stored on-site until permanent disposal is determined under the Remedial Investigation/Feasibility Study (RI/FS).

1.3 ANACONDA SMELTER

Ore was processed at various locations in and near the city of Anaconda from 1884 to 1980. Wastes from smelting operations have contaminated more than 6,000 acres with metals such as copper, cadmium, lead, zinc, and arsenic. Anaconda Minerals Company estimates that there are 185 million cubic yards of concentrated tailings, 27 million cubic yards of furnace slag, and 250,000 cubic yards of flue dust. Additional concerns at the site include arsenic levels in the community of Mill Creek as high as 3,350 ppm and an area historically used for beryllium disposal. Investigations are planned to define the extent of aerial deposition of smelting emissions which covers tens of square miles.

During operations from 1884-1902, wet milling tailings were allowed to run into Warm Springs Creek and over the surrounding land. Some of these tailings deposits contained as much as 5 percent copper and were re-mined, milled, and re-smelted. In 1904, various small ponds were constructed to hold these tailings, but frequently over-topped, spilling tailings onto the surrounding lands. In 1914, a series of ponds were constructed and abandoned as they filled with tailings, leaving mounds of tailings as much as 80 feet high. These ponds, Opportunity, Bradley, and Anaconda, cover over 4,000 acres.

1.4 MILLTOWN RESERVOIR

The Milltown Dam was constructed in 1907 of rock-filled timber cribs at the confluence of the Clark Fork and Blackfoot Rivers. It has been in continual use since that time as a hydroelectric generating station. The reservoir created by the dam has acted as a collection basin for the sediments carried by the rivers. These sediments contain high concentrations of arsenic, lead, cadmium, and zinc. These metals have contaminated the alluvial aquifer used for local drinking water supplies. An alternative water supply has been provided using Superfund resources. The source of these metalliferous sediments is historic mining and milling operations upstream on the Clark Fork River.

1.5 RELATED NON-SUPERFUND ACTIVITIES

Many non-Superfund activities initiated by state and federal agencies have important implications for the Clark Fork River Data System. Numerous non-Superfund activities have been initiated in the upper Clark Fork River Basin by state and federal agencies. These various activities involve water quality evaluations, soil erosion control, land reclamation, fisheries investigation, university research program, and other activities. Many of the programs have important implications concerning policy, community relations, and fundamental data collection and synthesis.

The Montana Governor's Office has initiated an interagency program to aid in the management and coordination of the Superfund and non-Superfund issues.

1.6 BACKGROUND OF CLARK FORK DATA SYSTEM

Each of the sites in the Clark Fork River watershed presents a highly complex series of human health and environmental problems. More importantly, the sites are inter-related to the extent that actions taken at one of the upstream sites can impact a downstream site. Clearly all activities within the upper Clark Fork Basin must be coordinated to maintain consistency in enforcement strategies, community relations and sequencing of remedial actions.

Recognizing that the same Potential Responsible Party (PRP) is involved in each of the major sites led to a decision to consolidate and coordinate the activities at all sites. A series of planning meetings were held in September-November, 1986, to outline a management plan for all Clark Fork Superfund sites. The meetings resulted in identification of management

strategies and an organizational structure with the goal of fulfilling Superfund requirements and satisfying state environmental laws.

The Clark Fork Cooperative Agreement provides for implementing part of the overall Clark Fork Coordination Plan. Specifically, the agreement encompasses the development and implementation of a coordinated common data management system for all Superfund sites in the Clark Fork River Basin; and, the development of a computerized Geographic Information System (GIS) for all major Superfund site data.

The intent of the Clark Fork Data Management System is to: provide a consolidated, centralized data system for the purpose of standardizing data collection, input/storage, QA/QC procedures; save funds through the elimination of payment for multiple systems development and maintenance by the various contractors involved; reduce data loss through direct control; improve data reliability; and to provide other agencies/organizations associated with the Clark Fork Superfund sites access to the data for the region as a whole.

The conceptual Data System configuration is presented in Figure 3. The personal computer (PC) based Data Management System currently being used to handle the bulk of the Anaconda site and Silver Bow Creek site data (Environmental Information System (EIS); see description in *Appendix E - Clark Fork Data Management System Structure*) will serve as the point of consolidation and standardization of the data collected as a result of Superfund site surveys. The Data Management System is located in the Montana Department of Health and Environmental Sciences (MDHES) and is staffed as needed to provide maintenance of the system, data import/export, and minimal service bureau access to project personnel. Project personnel within MDHES will have access to the system through a Novell Local Area Network (LAN). Manual data input and system development are provided through contracted services. Data required for mapping and spatial analysis will be transferred to the GIS on an as-needed basis.

The GIS was implemented as a component of the data system, intended for application to specifically defined projects requiring spatial analysis and mapping capabilities. The GIS consists of ARC/INFO software operating in a minicomputer environment. The GIS is located in the Montana State Library, and is staffed as needed to provide maintenance of the system, data import/export, and "service bureau" access to project personnel. Remote terminals or PCs with terminal emulation software will be used for direct access by project personnel where necessary. Uses and applications of the GIS will include: cartographic portrayal of data; modeling of most likely deposition areas, modeling of transport of hazardous substances through surface and groundwater; identification of priority sites for cleanup efforts; identification of areas where future settlement and land-use will be most hazardous. The system will be an extremely important tool in determining which sites should be given priority for cleanup. This decision will involve a great deal of money and the GIS system will ensure the best possible decision is made.

The main focus at this time is on conceptual and logical development. The first implementation should be viewed as a prototype development which will be very useful for organizational evolution in terms of helping to develop better concepts and structures, the development of trained staff and management, and the determination of how the systems best fit into the management and decision making process. It is certain that the rapid evolution in hardware and software will continue. Good concepts and structures can be more readily adapted to any new operating environment.

The strategy is therefore to: use existing components, integrate the components as much as possible, concentrate on good conceptual and logical models, develop organizational training, and develop experience on how the new flow of information fits into the respective organizations and how it can best be used in the decision making processes.

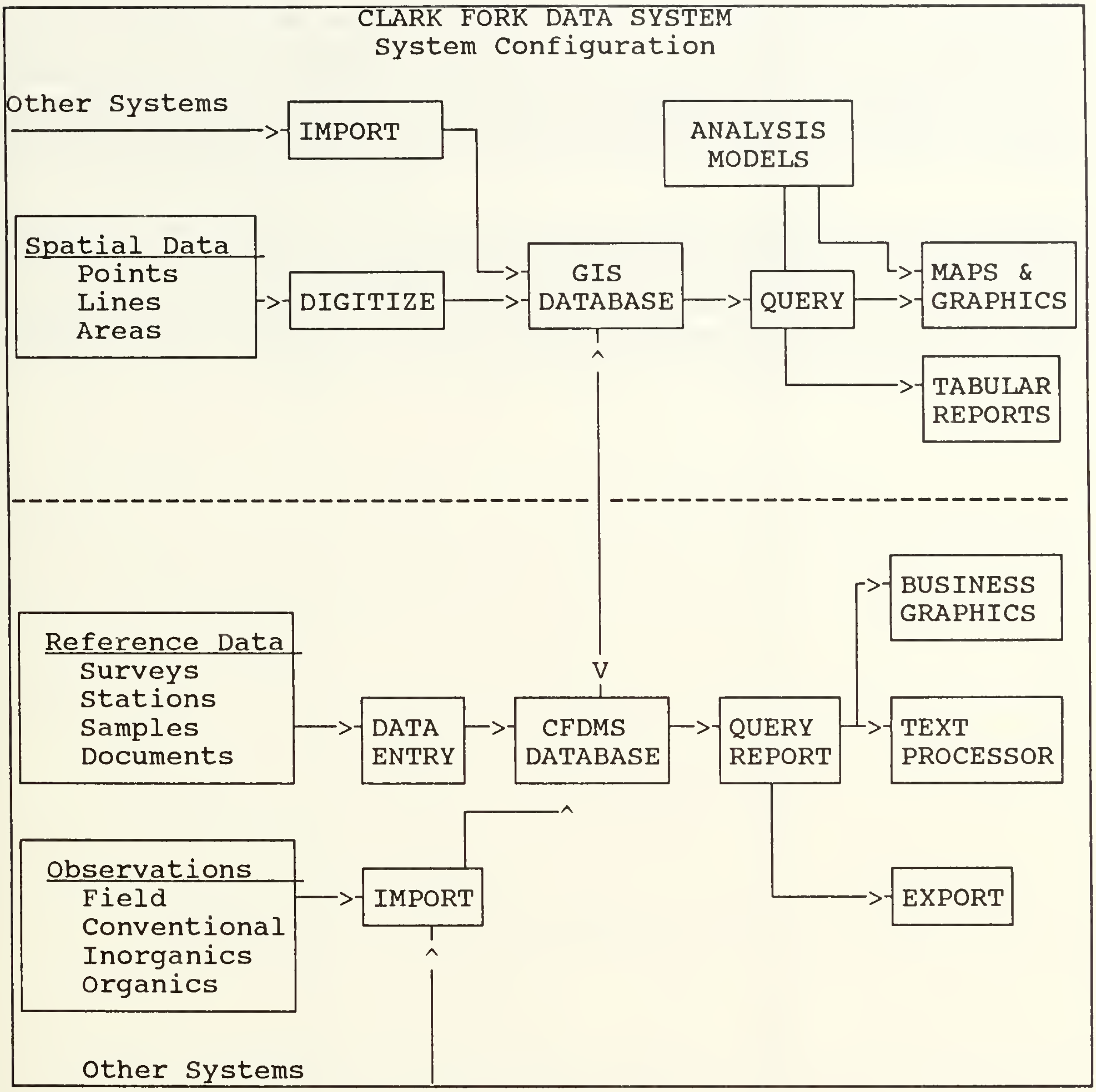


Figure 3 Clark Fork Data System Conceptual Model

As originally conceived, the Data Management System would remain the repository of Clark Fork Superfund Site data as long as the MDHES is involved in cleanup and subsequent monitoring at the sites. The GIS would serve specific mapping and spatial analysis functions as needed. As Superfund needs decrease, GIS services would be made available to others, thus decreasing the costs to the Superfund program. The method for making the GIS services more widely available is outlined in *Addendum A - Montana State Library Business Plan.*

It is important to note, however, that the system is dynamic and evolving. The Environmental Information System (EIS) presented a well documented, well developed and tested, essentially turnkey system to address the identified data management needs which could be put into place rapidly. However, the Data Management System is not so much the EIS but rather an effort to consolidate the data in a standardized, portable form which can be easily utilized in another

software or hardware operating environment if necessary. Reproduction of a system with similar user interface and integrity control in another environment would take considerable time and effort. EPA and MDHES data management plans are currently in a state of flux, with consideration being given to further attempts to standardize data management software and hardware among the agencies, possibly on a regional basis. Additionally, software vendors, including ESRI, the developers of ARC/INFO, are exploring methods of accessing other data systems from ARC/INFO.

The potential need for direct access to and usage of the data management system and GIS by project personnel will also play a major role in guiding the evolution of the both components of the data system. The need for project personnel to turn to the data system routinely for on-line general data management functions (and the relationship of those functions to GIS capabilities) and justification of the costs of developing and maintaining the system in another environment will be considered when choosing the best development pathway.

CHAPTER 2 - ORGANIZATION AND RESPONSIBILITIES

Chapter 2 outlines the functions, organization, and major tasks of the various state and federal agencies related to their involvement with the Clark Fork Data System. Figure 1 (Preface) graphically displays the relationships among the various organizations involved with the Data System. Each organization's function is described below. In summary, the Geographic Information System (GIS) is located in the Montana State Library and operates under a contract with the Montana Department of Heath and Environmental Sciences. The funding for that contract as well as for the Data Management System (DMS) at the MDHES are covered under the *Clark Fork Cooperative Agreement: Revision, August 1988* (see Appendix A). The EPA Montana Office and the MDHES each have the lead on various NPL sites and each make use of the Clark Fork Data System. The Technical Working Group and the Steering Committee are management tools for the administration of the cooperative agreement. EMSL-LV provides GIS support services for database design and creation, and applications development.

2.1 FUNCTION OF CLARK FORK TECHNICAL WORKING GROUP

PURPOSE: The purpose of the Technical Working Group (TWG) is to plan and manage the detailed operational aspects of the Data System using the *Clark Fork Superfund Data System Master Project Plan* as a guide. The initial focus is directed toward the use of the Data System by the Clark Fork Superfund project in Montana. The Technical Working Group is responsible to the Clark Fork Steering Committee.

PARTICIPANTS: The following agency representatives comprise the Technical Working Group membership.

- Montana State Library: Allan Cox

- Montana Department of Health and Environmental Sciences:
  James Hill, Kevin Kirley

- Environmental Protection Agency
  Montana Office: Bob Fox, Mike Bishop
  Regional Office: Larry Svoboda, Bill Monson, Gabriel Lucisano

- EMSL-LV: Mason Hewitt, David James

- Bureau of Reclamation: Dan Jewell

ORGANIZATION: The meetings will be chaired by the State Library representative. The State Library representative will also be responsible for calling meetings, developing agendas, and preparing minutes of all meetings. Minutes with attachments will be provided to the Steering Committee which is composed of agency managers at EPA and the State. Meeting frequency shall beat least every quarter, with more frequent meetings as needed.

MAJOR TASKS:

- Develop a comprehensive project plan:

  - Set project priority guidelines

  - Approve GIS projects

  - Review and update the project plan on a quarterly basis with an emphasis on

the data acquisition and applications section

- Develop and implement an accounting software system

- Develop and implement a data administration system

- Develop and maintain a strong and effective communication link with the Clark Fork Steering Committee

2.2 FUNCTION OF CLARK FORK STEERING COMMITTEE

As specified in *Report on the Clark Fork Geographic Information System Project* by Dan Yurman (July 29, 1988) a Steering Committee for the Clark Fork Data System Project was to be established. The following description is taken from that report and may be altered by the Steering Committee when they convene.

PURPOSE: The Steering Committee is to provide policy and oversight of the cooperative agreement that is the basis for the work by the State of Montana.

PARTICIPANTS: The following agency representatives comprise the initial Steering Committee membership:

- Environmental Protection Agency

  Regional Office:
  Robert Duprey, Director, Hazardous Waste Division
  James Lehr, Director, Environmental Services Division
  Kerrigan Clough, Director, Policy and Management

  Montana Office:
  John Wardell, Director, Montana State Office

- State of Montana:
  Larry Lloyd, Director, Environmental Sciences Division, MDHES
  Jon Sesso, Director, Montana State Library Natural Resource Information System

MAJOR TASKS:

- Provide policy and oversight of the cooperative agreement between EPA and the State of Montana which supports the Clark Fork Data System.

- Charter a Technical Working Group (TWG).

- Delegate to the Technical Working Group operational responsibilities for carrying out the terms, conditions, and scope of work for the Clark Fork Data System associated with the cooperative agreement.

2.3 FUNCTION OF EPA -- MONTANA OFFICE

PURPOSE: EPA has entered into a cooperative agreement with the MDHES to establish a Clark Fork Data System for the Clark Fork River Superfund Sites, to be comprised of a Data Management System component and a Geographic Information System component. EPA provides oversight of all activities conducted under the cooperative agreement.

ORGANIZATION AND KEY PERSONNEL:

Personnel in the Montana EPA Office are involved in the direct day-to-day management and oversight of the cooperative agreement, while personnel in the Region VIII EPA Office in Denver are involved in key funding decisions.

EPA Project Officer/TWG Representative Clark Fork Superfund Coordinator	Bob Fox
EPA Remedial Project Manager/ TWG Representative	Mike Bishop
Superfund Branch Chief	to be filled
Montana Office Director/ Steering Committee Representative	John Wardell

MAJOR TASKS

- Help establish goals and purpose of the Clark Fork Data System.
- Support the Data System with financial resources:
    a. Provide federal funds
    b. Approve Cooperative Agreement
    c. Manage Cooperative Agreement in accordance with applicable regulations

- Assure that EPA Superfund Program needs are adequately met while also assisting the development of GIS to address other environmental issues of federal and state interest.

- Assist in coordinating GIS applications and interactions with interested groups.

- Provide expertise to build overall state capability with GIS.

- Provide communication with the Region VIII EPA office.

2.4 FUNCTION OF MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

PURPOSE: EPA and MDHES have entered into a cooperative agreement which provides for MDHES to develop and maintain a data base of the data relating to the Upper Clark Fork Superfund Sites. MDHES and the State Library have entered into an interagency agreement to develop and maintain a GIS component of the Data System.

ORGANIZATION AND KEY PERSONNEL:

Responsibility for the Clark Fork Data System has been placed within the Environmental Sciences Division, Solid & Hazardous Waste Bureau.

Data Management System Manager/ TWG Representative	James L. Hill
State Project Officer/TWG Representative	Kevin Kirley
State Project Officer/TWG Representative	to be filled

Superfund Program Manager	to be filled
Section Supervisor	Vic Anderson
Bureau Chief	Duane Robertson
Division Director/ Steering Committee Representative	Larry Lloyd

MAJOR TASKS

- Cooperative Agreement Management (see *Appendix A - Clark Fork Cooperative Agreement - FY89*):
    - Develop work plans and associated budgets for data management component.
    - Review work plans and budgets for GIS component.
    - Maintain funding for the project through preparation of grant applications for review by EPA.
    - Submit an overall status report of data management and GIS activities to EPA every three months.
    - Submit special status reports to various individuals on an as needed basis as specific project applications are being carried out.
- Contract management:
    - Develop and manage an interagency agreement with the Montana State Library to implement the GIS component of the Data System *(Appendix D - MDHES/MSL Interagency Agreement)*.
    - Develop and manage contracts for Data Management System development and data input.
- Data Management System Administration:
    - Maintain an automated data management system for the purpose of consolidating and standardizing the structure of data collected relating to the Upper Clark Fork Superfund Sites.
    - Coordinate with agencies/organizations that input to the system to insure that data collected is properly structured.
    - Develop or aid in developing the ability within the system to respond to specific needs of individual project officers.
- Response to User Needs:
    - Provide reporting and analysis services to users.
    - Provide for access to data by EPA, contractors, and other users.

2.5 FUNCTION OF MONTANA STATE LIBRARY -- NATURAL RESOURCE INFORMATION SYSTEM

PURPOSE: The Montana Natural Resource Information System (NRIS) is a state government program created by the Montana Legislature in December of 1985 to design and implement a comprehensive system for the acquisition, indexing, and retrieval of important natural resource information statewide. NRIS is a centralized access point to decentralized data bases, and provides a means to make sources of information on Montana's natural resources easily and readily accessible to persons needing that information.

ORGANIZATION AND KEY PERSONNEL: The GIS Project is housed in the Montana State Library in Helena, Montana as a project of the NRIS program. State Library and NRIS personnel are listed in the NRIS organizational chart (Figure 4).

MAJOR TASKS: The responsibilities of NRIS as related to the Clark Fork Geographic Information System are to:

- Design and develop a geographic information system (GIS) to serve state needs, and promote coordination among the agencies developing their own geographic information systems to ensure compatibility and data-sharing capability;

- Through an interagency agreement with MDHES, provide support services pertaining to MDHES responsibilities in the Superfund Program, including but not limited to sites at Silver Bow Creek, Montana Pole, Anaconda Smelter, and Milltown Reservoir. Under the agreement, NRIS agrees to obtain, install, and operate a geographic information system for MDHES. Initially, the GIS will be used in support of the response process at the Clark Fork Superfund sites (Silver Bow Creek site, Anaconda Smelter site, and the Milltown Reservoir Sediments site). The responsibilities of NRIS include:

    - Technical Assistance: Generally these services relate to technical review and evaluation of the conceptual design of the Upper Clark Fork Basin Geographic Information System coordinated by the Environmental Monitoring Systems Laboratory - Las Vegas (EMSL-LV); feasibility studies and design documents; and participation in planning and review meetings.

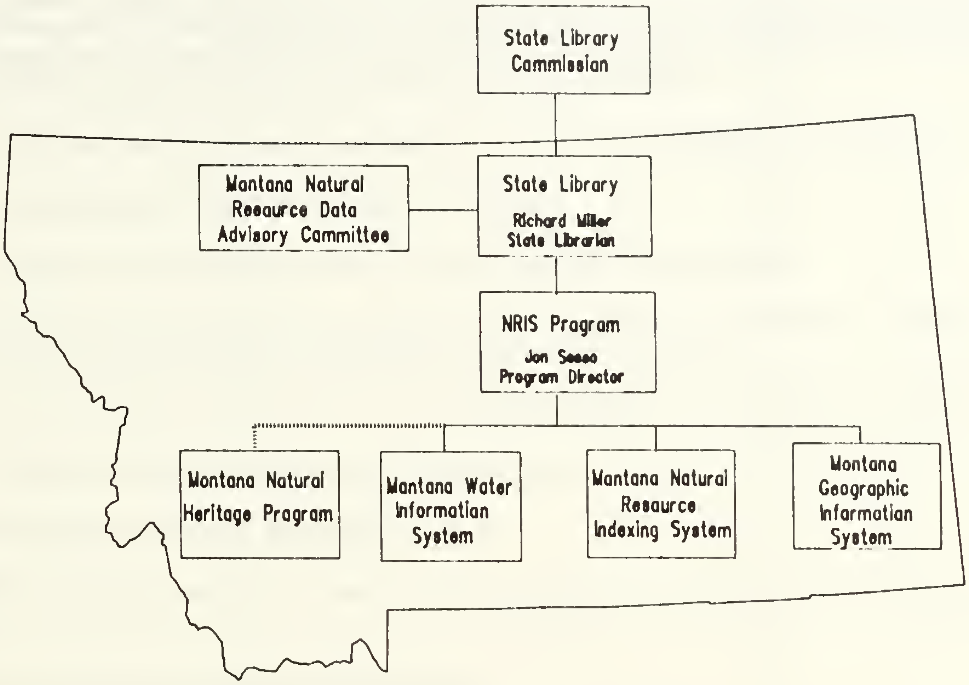
    - Geographic Information System Management: As the Upper Clark Fork Geographic Information System becomes operational, the NRIS will input, store, manipulate, and retrieve data pertinent to the sites covered by the Agreement. As part of the Agreement, NRIS will procure necessary hardware and software and train and make available staff for management of the Geographic Information System.

    - Interagency Coordination: Services include interagency coordination of GIS development and management, and briefings to other appropriate state agencies.

- The MSL is the manager of the "Primary GIS Database" for the Clark Fork Superfund Project. Other agencies (e.g., EMSL-LV, Bureau of Reclamation, EPA Region VII) will be holders of "Secondary Databases."

2.6 FUNCTION OF Environmental Monitoring Systems Laboratory-Las Vegas

PURPOSE: The role of Environmental Monitoring Systems Laboratory-Las Vegas (EMSL-LV) is focused on the applications development and GIS processing for the Clark Fork Project. Additionally, the Laboratory preforms a technical oversight and review function for operational GIS activities. It will examine complex technical problems for which there are no


State Library Commission
State Library
Richard Miller
State Librarian
Montana Natural Resource Data Advisory Committee
NRIS Program
Jon Sesso
Program Director
Montana Natural Heritage Program
Montana Water Information System
Montana Natural Resource Indexing System
Montana Geographic Information System

Natural Resource Information System

Montana State Library

NATURAL HERITAGE PROGRAM	WATER INFORMATION SYSTEM	GEOGRAPHIC INFORMATION SYSTEM	NATURAL RESOURCE INFORMATION SYSTEM
Dave Genter Coordinator 444-3009	Jim Stimson Water Information Specialist 444-5356	Allan Cox GIS Specialist 444-5357	Diane Capron Library Technician 444-5354
Steve Shelly Botanist	Pam Smith Library Technician 444-5354	Gerry Daumiller GIS Technician 444-5358	Jim Senkler Programmer/Analyst 444-5354
Andy Kratz Ecologist			
Margaret Zook Data Technician 444-3009			

Figure 4: NRIS Organizational Chart

staff resources either in Region VIII or the State. The Lab will assist the project in working through these problems, and make recommendations for feasible solutions for project analyses. As the EPA's Center of Excellence for GIS research, EMSL-LV is able to bring to bear substantial expertise and computer resources to assist with project plan development and execution.

ORGANIZATION AND KEY PERSONNEL:

Mason Hewitt, Environmental Scientist, (EPA)
David James, Senior Scientist, (Lockheed)

MAJOR TASKS: EMSL-LV's role in GIS support for the project will be transitional. As GIS expertise increases in the project staff, the nature and extent of EMSL-LV's support role will change. However, because the project staff's experience with GIS is still on a steep learning curve, the following activities can assist the Clark Fork GIS.

- GIS processing and applications development in response to project staff requests;
- Overall project design and development;
- Esoteric programming tasks for applications development;
- GIS installation support through the development of Arc Macro Language programs (AMLs) and other generic programs that may be useful;
- Incorporation of the Lab's present QA/QC research task into the project design; and,
- Use and integration of remote sensing data.

2.7 FUNCTION OF EPA REGION VIII

PURPOSE: EPA Region VIII personnel with experience in GIS will serve as advisors to the project.

ORGANIZATION AND KEY PERSONNEL:

Chief, Environmental Monitoring Assessment Section, ESD	Larry Svoboda
GIS Analyst, ESD/TWG Representative	Bill Monson
GIS Analyst, ICF Technology/TWG Representative	Gabriel Lucisano

MAJOR TASKS:

- Provide planning support to project development activities.
- Provide consultation and analytical expertise in GIS applications development and execution.
- Maintain Clark Fork Superfund data back-ups.
- Provide processing capabilities.
- Provide representation to the Clark Fork Technical Working Group.
- Provide representation to the Clark Fork Steering Committee.
- Provide data sharing between the region and the state of Montana.
- Provide GIS and database management training opportunities.
- Provide digital data as acquired through national data purchases.
- Assure compatibility with regional GIS program and with agency-wide initiatives for data/information sharing, management and analysis.

CHAPTER 3 - SYSTEM CONFIGURATION

Reference is made to Figure 3, Clark Fork Data System Conceptual Model (Chapter 1).

3.1 CLARK FORK DATA MANAGEMENT SYSTEM

The following sections outline the basic configuration of the Clark Fork Data Management System.

3.1.1 Hardware

The data management system is currently operating in a personal computer (PC) environment using an IBM PS/2 Model 80. The system is accessible through a PC Local Area Network (LAN) serving the MDHES Solid & Hazardous Waste Bureau. Telecommunications equipment (Hayes compatible 2400 baud modem, Crosstalk Mark IV software) is provided to effect rapid data transfer. An IBM Proprinter XL24 is used for report and graph production.

3.1.2 Software

The data management software utilized is the Environmental Information System (EIS), an implementation of Knowledgeman/2 (Micro Data Base Systems, Inc., Lafayette, Indiana, 37902) developed by Environmental Systems Corporation of Redmond, Washington. The EIS provides a relational data structure, generalized (not project specific) subject data tables, integrity control, and an effective operator interface. Other software utilized by the system includes WordPerfect (WordPerfect Corporation, Orem, UT, 84057) and Lotus 123 (Lotus Development Corporation).

3.1.3 Personnel

The Data Management System is staffed with a full time administrator, who is responsible for system implementation and development and maintenance of the integrity of the system, as well as importing/exporting data, coordination with the GIS component and satellite data systems, and management of the cooperative agreement and contracts through which the data system operates. MDHES Solid and Hazardous Waste Bureau management and support staff are available as necessary.

3.2 CLARK FORK GEOGRAPHIC INFORMATION SYSTEM

The following sections outline the basic configuration of the Geographic Information System.

3.2.1 Hardware

The hardware consists of a PRIME 2755 mini-computer with supervisor's system console and line-printer, two Tektronix 4111 graphic terminals, a Compaq 386 PC with hi-resolution monitor, a Zenith PC with Tektronix Terminal Emulation, a Calcomp 9100 Digitizing Table, a Tektronix 4696 color ink-jet printer, and Calcomp 1044 8-pen roll-feed plotter. The DMS PC also serves as a terminal to the Prime, using Tektronix terminal emulation. Planning is currently underway to provide a computer data line to the Montana EPA office. This line will provide direct on-line access to the GIS for EPA personnel using PCs. Figure 5 depicts the GIS hardware configuration.

3.2.2 Software

The GIS uses two principle software packages: ARC/INFO and ERDAS. ARC/INFO is a vector-based GIS program that stores data using a relational and topological data model.

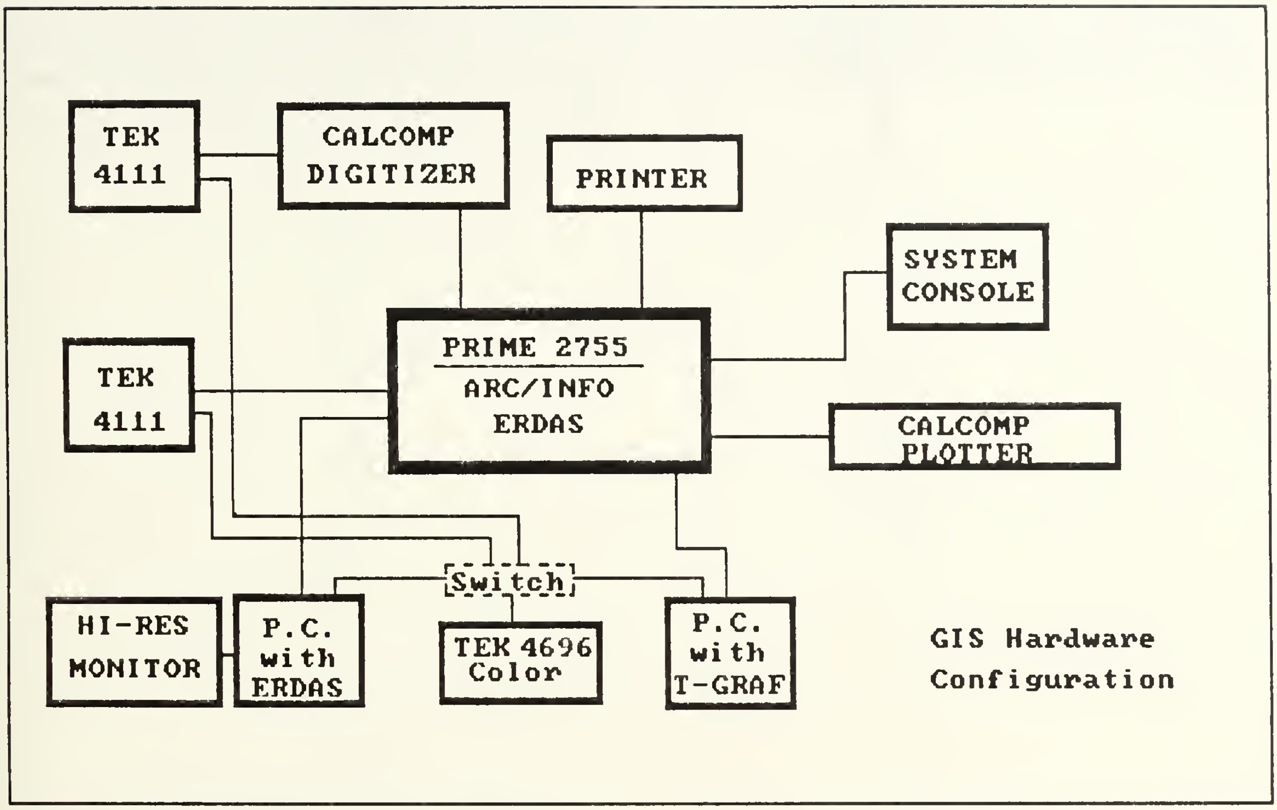


Figure 5 GIS Hardware Configuration

ARC/INFO functions include: the input of data; editing of both spatial and attribute data; performance of a variety of geographic analyses; and composition and plotting of maps. The MSL installed the ARC/INFO TIN Module (Triangulated Irregular Network) in Spring 1989. The TIN module will enable the users to create, analyze, and display digital Z-value (e.g., elevation) data.

ERDAS is a raster-based image processing and GIS program which allows for the input of remotely sensed digital data; image analysis and processing; basic GIS analysis; and the ability to transfer data between ERDAS and ARC/INFO. ERDAS features include:

- **Image Processing:** enhancement, geometric correction, classification.
- **Geographic Information System:** display, entry, updating, and analysis; and merger with remotely sensed data.
- **Utilities:** routines for file modification/annotation, demonstrations and diagnostics.

The Compaq PC acts as a work station for ERDAS, which resides on the Prime minicomputer. Data are displayed on the PC's high resolution monitor directly from the Prime. Detailed descriptions of ARC/INFO and ERDAS are contained in the *Clark Fork GIS Resource Document*. A list of the hardware and software names and vendor addresses is contained in *Appendix F - Hardware and Software Vendor Chart*.

3.2.3 Personnel

The GIS has two full-time employees--a GIS Coordinator responsible for project administration

and GIS analyses, and a GIS Programmer/Analyst responsible for programming on the system. The NRIS data technician and the NRIS Administrative Assistant each devote 25% of their time to the GIS. In addition, the NRIS Director devotes part of his time to GIS duties. A full-time GIS Technician will be hired in December 1989.

4.1 INTRODUCTION

Chapter 4 constitutes the Data Administration Plan. Figure 6 schematically displays the basic flow of data and the scope of this plan. The Data Administration Plan sets forth procedures for management of data received from EPA, Potentially Responsible Parties, contractors, and other data sources. Project data development needs are set forth to provide a framework for the development of data management objectives and practices which will ultimately support Superfund issues. The flow of data from the source into the Clark Fork Data System, between the components of the Data System, to and from external models and analysis systems and from the Data System to end users is described. A procedure is described for handling QA/QC information to allow for differentiating between data on the basis of the quality of the data.

As described in Chapters 1 and 3, and graphically represented in Figure 3, the Clark Fork Data System is comprised of two distinct but interrelated components: the Clark Fork Data Management System located in the Department of Health and Environmental Sciences; and the Clark Fork Geographic Information System located in the State Library. Depending on the type of data, data may enter the Data System through either of the two components of the System. Although this Data Administration Plan is for the most part concerned with what happens to the data from the point where they enter the System, specifications are also set forth which describe the structure required for communication of data to the System, and which identify information which must be provided in order for the data to be integrated with other data in the System. Procedures are described which provide a means for these needs to be communicated to the data collection agency/organization.

The procedures and documentation described in this Data Administration Plan are necessary to verify the quality of the analyses conducted to facilitate Superfund decisions. The Plan must therefore set forth procedures which will support and enhance the intended use of data collected. Equally important is the need for standardized procedures for the collection, analysis validation and assessment of data, in order to facilitate management of data from many sources in an integrated system.

The Data Administration Plan serves two purposes:

1. The Plan provides a means to identify data use objectives and to describe the data management practices implemented to fulfill those objectives.
2. The Plan serves as a reference document for data management staff.

In order to serve this dual purpose, the discussion contains general descriptions of procedures, and also contains technical information for use by data management staff.

The Data Administration Plan is divided into three parts:

1. Project Data Development,

2. Data Administration for the DMS, and

3. Data Administration for the GIS.

4.2 PROJECT DATA DEVELOPMENT

The four Superfund sites on the Upper Clark Fork River have been separated into operable units, each of which may pose imminent and substantial risks to human health and

environment. Investigations within these operable units may be conducted for reasons which vary from waste type to waste type. For example, a removal action at one operable unit which requires only the identification of the highest levels of contamination would not provide the information needed for a more complete remedial action, which would require documentation of cleanup activities to a lower level of contamination. Therefore, data quality objectives necessary to meet Superfund requirements may not be uniform from operable unit to operable unit. The following discussion of data development considers that data that are uniquely suited to the site specific data quality objectives must be pursued.

Project data development describes the process by which the data necessary to support the decision-making process is produced. The process is described here for the purpose of providing the framework for development of the data administration practices which follow.

4.2.1 Data Development/Management Objectives

Significant effort is directed at developing quality assurance/quality control procedures that will facilitate the acquisition, quantification, and dissemination of environmental data that may be used in support of Superfund activities. Considering the importance of the decisions that are made as part of the Superfund process, both in terms of cost and the effect on people's lives, it is paramount that data used are of sufficient quality and integrity to support the Superfund decisions at hand. The environmental and spatial data addressed by this Data Administration Plan may be used in support of remedial investigations and feasibility studies (RI/FS), endangerment assessments/public health evaluations, remedial design, remedial action and other associated Superfund documentation.

The following steps are required to develop a reliable data system which integrates data from several sources and which supports the data development/management objectives as described above:

1. Data must be collected, analyzed or evaluated according to a consistent set of criteria.

2. Data must be properly qualified, and reported in proper units.

3. Data must be properly identified, entered, and verified.

4. Data values must belong to explicitly defined domains (data integrity must be maintained).

Steps 1 and 2 must be influenced by the Data System staff. Steps 3 and 4 can be controlled by the Data System staff. Step 1 requires the expertise of technical personnel trained in collection, analysis, and QA of environmental data of various types. Step 2 involves interaction of data management staff with these technical personnel in the proper coding of data.

Interaction between the Project Officer for a project, the data collection contractor, the QA/QC contractor, and the Data System staff in developing a Data Management Plan can improve the flow of data and ensure maximum possible accuracy and efficiency in data reporting and data entry.

4.2.2 QA/QC Objectives

QA/QC objectives should apply equally to spatial data as well as to laboratory and other data. The production of valid and acceptable data begins with setting sound data quality objectives in Quality Assurance Project Plans (QAPPs) and Sampling and Analysis Plans (SAPs) for the Clark Fork Superfund sites, prior to the collection of field data. Similarly, appropriate

handling and analytical techniques must be identified in the Laboratory Analytical Protocol (LAP) and/or SAPs in order to maximize the consistency, utility and accuracy of the data being produced. Information specified in the previously mentioned documents should be consistent with EPA guidance on these topics including the QAPP for the Office of Emergency and Remedial Response and Office of Waste Programs Enforcement (OSWER Directive 9200.1-05) and Data Quality Objectives for Remedial Response Activities (OSWER Directive 9355.07B). In addition to EPA guidance, the project attorneys, the Region VIII Quality Assurance Officer, and the Project Officer must address collection and tracking of documentation including chain of custody and other key evidentiary documents. Each project manager should strive to maintain consistency between the sites by consulting with other project managers when dealing with a data collection task that may have been previously addressed on another site.

The QAPPs for the sites should be developed in order to assure that precision, accuracy, completeness, representativeness and comparability of data are known and documented in a consistent fashion during the RI/FS or removal projects on the site. The QAPP represents the first level of quality assurance/quality control (QA/QC) requirements; although further detail and refinement of quality assurance, quality control, handling and analytical procedures can be provided in operable unit-specific SAPs.

The LAPs for the sites should specify the handling and analytical procedures for matrices that will be sampled on the site. Under circumstances where the handling/analytical procedures specified in the LAP do not meet the data quality objectives specified in operable unit-specific SAPs, alternative procedures should be provided in operable unit-specific SAPs.

Following the establishment of appropriate procedures in the QAPP, LAP, and SAPs, the production of valid and acceptable data is accomplished by thorough documentation of all field, field laboratory, and analytical laboratory procedures and by the analysis of quality control (QC) checks and adherence to specified QC statistical control limits. Documentation requirements include the maintenance of field data and logging sheets, books, chain-of-custody and analysis request forms, and the reporting of laboratory sample and QC results in detail and on special forms. The elements of quality control fall into three groups:

1. Instrument QC checks are designed to ensure that any instrument is calibrated and functioning properly.

2. Method QC checks are designed to monitor the precision and accuracy of both sample preparation and analysis; method QC checks may in addition provide information on intra-laboratory reproducibility of a method, and matrix effects.

3. Field QC checks are designed to monitor sampling by itself and the overall process of sampling, sample preparation, and analysis.

The sites QAPPs, LAPs, SAPs and associated Work Plans should specify the documentation and quality control requirements that apply to each of these QC groups. Ultimately, the QA/QC objectives and the performance within these objectives determines the utility or usability of data. Data usability is determined by comparing the degree of conformance of a given body of data with project-specific criteria. Data validation is an evaluation or the analytical quality of the data and is one of several separate processes required to determine data usability. In addition to the data validation criteria, appropriate documentation must be available to support the usability of data within the context of EPA/Region VIII's level A/B criteria.

4.2.3 Data Evaluation

Evaluation of data determines the appropriate end use of the data regerencing the applicable

prohect documents/requirements. The process takes part in two to three steps, depending on the project requirements.

1. Laboratory Data Validation - Data validation review includes the data validation process and can include an evaluation report of documentation, chain of custody and other potentially legally defensible information. The data validation review references the U.S. EPA Functional Guidelines for Inorganic Data Validation (SOP) 1987, 1988. The process insures compliance with the Contract Laboratory Program (CLP) Statement of Work (SOW) 1987 and/or other requirements as stated in the project documentation (QAPP, LAP, SAP, etc.). As a result of the data validation process, records are marked with codes or "qualifiers" indicating where specific quality control limits for the analyses were not met. The data can be categorized during this process as acceptable (no qualifiers), estimated ("J" qualifier), or rejected ("R" qualifier). Field QC may also be tracked and tabulated, although the data are not currently qualified on the basis of field QC.

2. Level A/B Review - A Region 8 Level A/B-type evaluation can also be conducted, which reviews all the project documentation. Level A/B review references the U.S. EPS Region 8 guidelines. This evaluation ensures that particular documents, chain of custody, names of personnel, dates and specific deliverables are present and that they are adequately documented to meet the legally defensible criteria for the product.

3. Data Assessment - The processes of data validation and Level A/B review do not specify how data can be used, whether data should be used with limits, or whether data should be rejected. Data assessment is the determination of the use of the data in terms of project objectives. Data assessment describes the process of examining the data in light of the methods used to generate the data along with the qualifiers added during the validation process and the Level A/B designation, and then determining which data are usable for a particular application. Data may be sorted into usability categories (i.e. enforcement quality, screening quality, unusable). Data usability categories and their relationship to the superfund process are described below.

The net effect of these processes is an assurance to the project manager that sufficient data of suitable quality are available to support a specific Superfund activity.

4.2.3.1 Data Validation

The EPA Contract Laboratory Program (CLP) Statement of Work for Inorganics (SOW 787) describes certain "flags" which are to be attached to laboratory results as a process notation. These flags have been modified from year to year as the SOWs are updated. Flags are strictly laboratory notation and are not considered to be data validation criteria.

The EPA Laboratory Validation Functional Guidelines for Evaluating Inorganics Analyses (1985 and July 1988 revisions) are considered to be standard criteria for the validation of data for interpretation of project data quality. The SOP is always used in correlate to the CLP SOW in use at the time of the analyses. The SOP describes certain "qualifiers" which can be associated with data which do not meet specific CLP QC limits as determined during the data validation process.

In order to integrate data from the various superfund sites in the Clark Fork region, it is absolutely imperative that the flags and qualifiers attached to the data result from standardized procedures and carry the same meaning from year to year and from site to site. Options range from the simple (designation of data as "qualified" or "not qualified", which would effectively translate to rejection of any qualified data) to the complex (development of a standard system which provides a means to utilize more data and which serves the needs of project personnel throughout the Clark Fork region).

The first option is not reasonable as it severely restricts the utilization of data. The second option is difficult to implement as it involves the adoption of a standard which must then be adhered to by all who contribute data to the system. The standard must provide the means to integrate data from various investigations and yet be flexible enough to accommodate varying needs from site to site. In spite of the difficulty in implementing the second option, the potential benefits to be derived make it worthwhile to do so.

The qualifiers and flags assigned during the analysis and data validation review are commonly carried in data summaries and reports. In order to maximize data utilization, the actual results of the laboratory QA/QC checks must also be carried with the data. For example, if arsenic was qualified as estimated (J) due to a quality control spike recovery of 45%, the qualifier would normally be "J", which provides no information as to why the value was qualified. However, by carrying the laboratory QC information in the data system, reports can be produced which greatly enhance the users ability to determine data usability. For example, the meaning of a qualifier is enhanced or clarified in a report by the placement of an additional code ("S" for "Spike") and the related value ("45"), resulting in the qualifier "JS45". The purpose is to maximize the usability of the data by using the qualifier values to sort on levels of qualification as well as to define patterns of qualifiers. For example, analytical results which have QC values which exceed the data validation control limits might still be used for screening decisions. There may also be reproducible matrix effects which should not disqualify the data, but which might provide useful information regarding the geochemistry of the site. These levels and patterns can be defined through analysis of the QC data. It is also conceivable that QC windows may be altered for a specific operable unit or for a specific waste (as supported by the applicable data quality objectives). By carrying the qualifier and the value of the QC parameter in the data system with the analytical results, the data validator is better able to sort data according to usability categories.

The amount of information to be processed to effectively utilize the QC data mandates that a computer aided analysis system be employed. The Data Management System component implemented to handle the QA/QC information generated is described in section 4.3.1.3.

4.2.3.2 Data Assessment

User Standpoint:

EPA guidance concerning the quality of data (OSWER Directive 9355.0-7B) recommend the establishment of five analytical support levels in order to categorize data based on the type of technology and documentation used and their degree of sophistication. These five analytical support levels follow:

LEVEL V DATA

DEFINITION- Non Standard Analytical Procedures. Analyses which may require method modification and/or development. Contract Laboratory Program (CLP) special analytical services (SAS) are considered Level V or Level III data depending on the degree of development required.

USES:
- Confirmational
- Toxicology
- Site-specific conditions/parameters
- RCRA compliance

LEVEL IV DATA

DEFINITION- CLP routine analytical services (RAS). This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data. This level of data may be produced from other than CLP labs if similar procedures are implemented.

USES:

- Confirmational
- Toxicology
- All other Superfund program activities

LEVEL III DATA

DEFINITION- Laboratory analysis using methods other than the CLP RAS. Some procedures may be equivalent to CLP RAS without the CLP requirements for documentation.

USES:

- Engineering studies
- Confirmational, but with less documentation
- Presence or absence of contaminants
- Screening

LEVEL II DATA

DEFINITION- Field analyses. This level is characterized by the use of portable analytical instruments which can be used on site, or in mobile laboratories stationed near a site. Depending on the types of contaminants, sample matrix, and personnel skills, quantitative data can be obtained.

USES:

- Presence or absence of contaminants
- Relative concentrations
- Engineering studies
- Screening

LEVEL I DATA

DEFINITION- Field screening. This level is characterized by the use of portable instruments which can provide real-time data.

USES:

- Assist in identifying sample locations
- Field screening
- Health and Safety

Experience on the sites has shown that these analytical support levels can demonstrate the sophistication of the analytical procedures; however the levels can lead to some confusion concerning how well the levels affect the uses of these data. For example, several levels of data may be used for endangerment assessment activities, or RI/FS engineering calculations. Use of the Data Management System to process the QA/QC information provides a means to rapidly classify the data into meaningful usability categories. In order to provide a classification of data that is user oriented, the following three data utilization categories can be derived:

ENFORCEMENT QUALITY DATA

Data usable for RI/FSs, endangerment assessments, public health assessments, and/or for remedial design. These data include:

- those which came through the data validation process and the Level A/B evaluation without qualification; and,
- those for which a consistent, reproducible matrix effect is evident in the pattern of qualifiers for a specific site or matrix. In this case, the data may be categorized as litigation quality with a known bias as justified in the administrative record.
- high hazard data. Included here are analytical results which have a value greater than a given agreed upon value. Qualifiers may not be necessary or statistically significant given the extreme levels of the analyte in the sample. Data may be classified as high hazard/enforcement quality on a case by case basis.

SCREENING QUALITY DATA

These data could be used to help develop or refine study plans or evaluate different sampling and analysis techniques. Screening quality data would generally include data sufficiently meeting the QA/QC requirements/documentation to meet the intended use of the data as stated in the data quality objectives. These data include those for which the QC control limit windows have been expanded, as justified in the administrative record and with the agreement of all parties involved.

UNUSABLE DATA

Data which violate the QC control limits for acceptability or have significant documentation missing or incomplete and are therefore not usable for Superfund activities.

This multi-tiered approach to data utilization will allow project managers to plan ahead during the setting of data quality objectives to provide data that will meet specific intended uses. Documentation concerning the quality of the data must also be maintained by the project manager. The sorting of data into these or similar usability categories will assure that suitable data can be made readily available to project engineers, toxicologists, and planners.

A computer aided analysis system is necessary to facilitate the assignment of usability categories on the basis of user defined standards. The Data Management System component implemented to handle the data usability information is described in section 4.3.1.4.

4.2.4 CLARK FORK DATA SYSTEM DATA SPECIFICATIONS

Data collected prior to the implementation of the Data System and data collected by agencies or organizations for purposes not directly related to Superfund activities may not include required information or may not be structured in a manner which facilitates the importation of the data into the Data System. In order to insure that data collected after the implementation of the Data System is properly structured and complete, specifications have been developed which set forth the required structure of data destined for eventual communication to the Data System. Project managers may include these specifications in their contractor and PRP work plans. These specifications consist of general guidelines for data management and two attachments that provide more specific detail for data input to the Data System. The specifications and attachments are found in *Appendix G - Data Specifications.* A Data Management Plan will be prepared by the data collection agency for all data collection efforts to take place after the implementation of the Data System. The Data Management Plan will provide guidance in conducting data evaluation and preparing data for entry into a database. Some of the features that can be specified in such a plan include:

- Criteria for evaluating historical data

- Criteria for evaluating data from an analytical lab

- Information that must be gathered in the field and in the lab

- Proper identification and qualification of data

- Forms on which data are to be provided and formats or units in which data are to be reported.

- Description of manual or automated data management system utilized.

- Analysis of methodology for communication of data to the Clark Fork Data Management System.

4.3 CLARK FORK DATA MANAGEMENT SYSTEM - Data Administration

The following section describes the handling of data within the Clark Fork Data Management System. Operational details necessary to satisfy the data use needs set forth in the previous sections are provided. The structure of the Data Management System is described in *Appendix E - Clark Fork Data Management System Structure.* A detailed description of the structure of the Data Management System can be found in the document *Clark Fork Data Management System Coding Specifications*, available from the Data System Administrator.

4.3.1 Data Flow

The flow of data to, within, and from the DMS is depicted in Figure 7 - Data Management System Data Flow. Reference numbers below correspond to the numbered steps shown on the chart. Data are depicted as layered pages and are referenced with the letter "D". Processes are depicted as boxes and are referenced with the letter "P". Data management systems are depicted as circles and are referenced with the letter "S". Data flow is depicted by arrows and is referenced with the letter "F" where necessary to explain flow path options.

Data handling and preparation involves a series of coordinated steps using both technical staff and the Data System staff in various decision-making capacities.

Historical studies, recent surveys or ongoing monitoring efforts may generate data for the Data System. These data may be received as a summary report or as raw data sheets (e.g., from the analytical laboratory), or they may be received in machine-readable format after initial processing by the agency or organization collecting the data.

(D.1.) Field, laboratory, and support data are assimilated in hard copy. Such data includes but is not limited to:

Reference data - Who/what/when/where/why

Observations - Measurements or observations made in field

Analytical results - Results of laboratory analysis

QA/QC data - Lab QC data/documentation of procedures

Documentation - Work plans/sampling plans/field & lab records

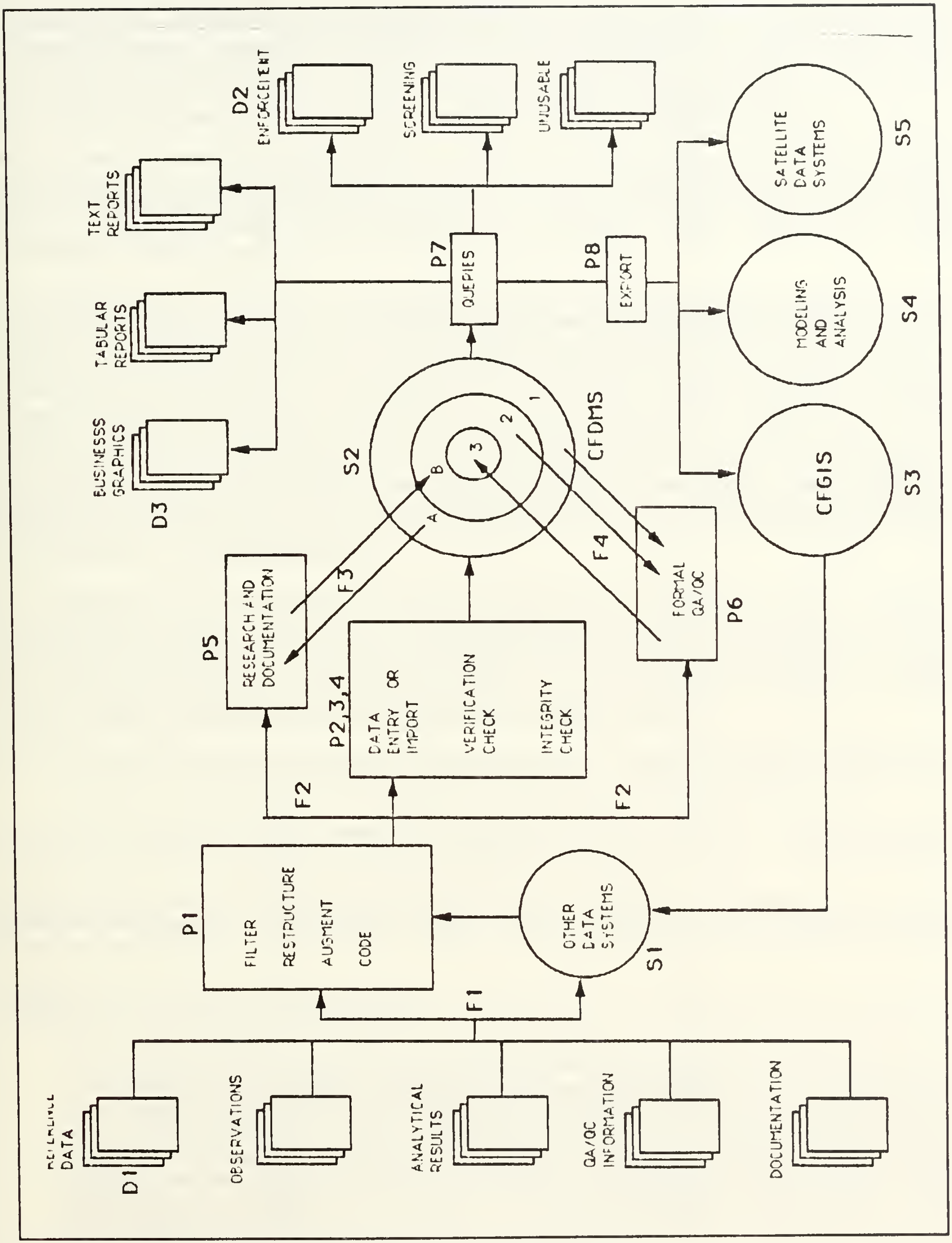


Figure 6 Clark Fork Data Management System Data Flow

(F.1.) It is not intended that the DMS replace existing data management systems used by the agencies and organizations collecting data relating to the Clark Fork Superfund Sites, nor is it expected that all agencies and organizations collecting such data will utilize the same software for data management within that agency or organization. Data may therefore be provided to DMS staff in hard copy or may be entered into another agency's or organization's data system, (S.1.) and then provided to the DMS in machine-readable format.

Prior to being submitted to the Data System staff, data will have been reviewed by project staff using predetermined criteria for its pertinence, and for appropriateness of field and lab methodologies, sampling design, and analyses. As a result of the data evaluation, certain data will be judged acceptable for inclusion in the database. Other data will be judged unacceptable and rejected.

(P.1.) Data judged acceptable for inclusion will then be evaluated by the Data System staff to determine if all information required for use within the Data System is provided. Data collected by agencies not associated with Superfund and data collected through Superfund related survey efforts prior to the implementation of the Data System may not be formatted as necessary for direct input into the DMS. Such data are filtered to eliminate unnecessary items, restructured to match the DMS structure, augmented where necessary to add items necessary in the Data System environment, and coded if provided in hard copy only. Contracts and work orders resulting in data collection after implementation of the Data System will require that the contractor collect all necessary information, code the data using DMS forms (insuring proper structure), and, optionally, enter the data into a computerized data system which has the capability to provide machine-readable data to the DMS in the required format. See *Appendix G - Data Specifications.*

(P.2.) Data are manually entered (if hard copy) or imported (if machine-readable). Data entry or importation will be performed by MDHES personnel, by data validation contractor personnel, or through contracted services. Importing of data will be accomplished through the use of Knowledgeman/2 programs established for that purpose, utilizing a common intermediate file format. Files from external data systems utilizing Knowledgeman/2 can be directly imported, again using Knowledgeman conversion routines.

(P.3.) Verification checks as described under Section 4.3.1.1 Data Input and Verification are run to insure that errors were not introduced in the entry or importation process.

(P.4.) An automated integrity analysis as described under Section 4.3.1.4 Data Integrity is performed on all data to insure entity and referential integrity.

NOTE: Procedures for handling data validation information in the data base are being developed and tested. The discussion which follows relating to data validation should be viewed as tentative.

A QLEV field is found in observation tables, where the level of data quality information available for a record can be recorded.

> In certain instances, as when dealing with historical studies, data may be entered into the DMS (S.2.) without first undergoing a formal data validation review. In this case, each record carries a "0" in the QLEV field, indicating that little is known about the lab QA/QC procedures, chain of custody information, and other information used to ascertain data quality. It is important to note that data categorized as level "0", where limited documentation and QC in formation is available, potentially have limited application to Superfund activities without significant justification in the administrative record.
>
> Data resulting from analysis through the EPA Contract Laboratory Program (CLP) are

associated with laboratory process flags (CLP "Q" qualifiers) when reported. Although these flags do not carry the significance of qualifiers added through a formal data validation review, they can be useful in the absence of other data quality information. Data imported with associated laboratory "Q" qualifiers are identified by a "1" in the QLEV field.

In the majority of cases, an associated data validation process is called for through the contract relating to the data collection effort; data are therefore provided to the data validation contractor for evaluation. (F.2.) The QLEV field is assigned a "2", indicating that the data validation qualifiers have been assigned as a result of a data validation process performed by a PRP contractor, or a "3", indicating that the data validation process has been performed by an EPA/DHES contractor.

If, in addition to the data validation qualifiers, the laboratory QC data is available, the QC data may be imported, along with "descriptors" indicating which QC test resulted in the qualification of the data. The analytical data may then be supplemented in reports with "descriptors" and QC test values which further document the reason for the assigned qualifier, and enhance the ability of the reviewer to determine data usability.

(P.5.) The standard data validation evaluation procedures are completed. At this point appropriate qualifiers describing the results of the lab quality control procedures are entered. The data, along with the added data validation information, is transferred to the DMS (S.2.). Each record carries a "2" or "3" in the QLEV field, indicating that the record was subjected to the formal data validation process and that appropriate qualifiers have been assigned and imported.

(F.3.) Data which carries a "0" or "1" in the QLEV field may subsequently be subjected to a formal data validation process. The QLEV flag is then changed to "2" or "3" (qualifiers have been imported).

An ABLevel field is provided in each observation table, where the results of a "Level A/B" evaluation is recorded.

Data may be entered into the DMS for which little is known about the history of the sample. In this case, each record carries a "U" in the ABLEVEL field.

Data having undergone a Level A/B review to ascertain the history of the sample will carry an "R" (rejected), "A" (meets level A), or "B" (meets level B).

(P.6.) Data with a designation of "U", "R", or "A" may be upgraded through research and documentation of the sample history.

(P.7.) Queries of the data in the system are made:

(D.2.) Data which carries a "2" or "3" in the QLEV field may be further evaluated using data assessment procedures to describe the utilization categories for the data as enforcement, screening, or unusable quality of data. These concepts have been previously described under the Data Validation section.

(D.3.) Tabular and text reports and business graphics are produced.

(P.8.) Data are exported to other systems, including the Clark Fork GIS (S.3.), systems providing sophisticated modeling and analysis (S.4.), and satellite data systems (S.5.). As a general rule, data will not be utilized in analyses or provided to other agencies or organizations until:

a. the QA/QC procedures specified in the associated QAPP have been completed and the data is properly qualified;

b. verification checks have been completed to eliminate data entry errors; and,

c. integrity checks have been completed to prevent lost or erroneous data.

4.3.1.1 Data Input and Verification

General and table specific data coding forms and instructions have been developed for each of the tables utilized by the Data System. Agencies or organizations responsible for coding data will be provided with the necessary forms and instructions, along with current lists of acceptable codes. General and table specific forms and instructions are constantly evolving and are therefore not made a part of this plan. Agencies/organizations responsible for data collection and recording can obtain current forms and instructions from the Data Management System administrator.

Manual data entry will be completed by the Data Management System administrator, department staff, or through contracted services. In some cases manual data entry may also be performed by the data validation contractor during evaluation of the quality of the data.

Approaches to verifying data will include:

- Using printouts of data to verify the entered values against the values in the original document

- Selecting for data values that are outside a given range of values

- Graphing sets of values and looking for outliers.

- Using available software to perform statistical analysis on data sets to determine the probability of a given figure.

- Using the GIS to plot locational information to be compared to known features

4.3.1.2 Data Documentation

The history of all data incorporated into the system will be maintained for the purpose of demonstrating the accuracy and integrity of the data. The DMS provides a structured system for the development and maintenance of such documentation.

A record in the SURVEY (CFRSU) table will be completed for each survey under consideration for entry into the system. Records in referenced tables (i.e. ROLODEX [EISRDX], RECORDS AND DOCUMENT MANAGEMENT [EISRDM], ORGANIZATION [EISORG]) will be completed as necessary to maintain the integrity of the SURVEY record.

Each record in all data tables contains a field labeled "REVIEWER". The identification code for the person responsible for judging the data to be acceptable for inclusion in the system will be entered into this field for each record added. The person making this determination will normally be the Data System administrator, a site project officer, or the site QA/QC contractor.

Each record contains fields labeled "RECORDER" and "RDATE". The identification code for the person responsible for coding the data along with the coding date will be entered into these

fields for each record added. In cases where the data are entered directly from lab sheets or other references, the identification code of the person performing the data entry and the date of data entry will be entered.

Each record contains fields labeled "EDITOR" and "EDDATE". The identification code for any person who edits a record and the date of editing is automatically stamped into the record by the system.

A record is manually added to the SYSTEM NOTES (NOTES) table whenever an action is taken which affects data in the system. Such actions include, but are not limited to, coding actions, input actions, verification, and important and relevant discussions relating to the survey. The note record is automatically linked to the table and record affected, the person making the modification and the date and time of modification. The system notes are sorted by survey on a regular basis and the reports filed with the survey reference documents.

4.3.1.3 DMS Implementation of Data Validation

NOTE: Procedures for handling data validation information in the data base are being developed and tested. The discussion which follows relating to data validation should be viewed as tentative.

The data validation component has the ability to carry the laboratory process flags assigned during analysis, and the standard qualifiers normally assigned during data validation review. Additionally, the component has the ability to carry the laboratory QC information associated with the assignment of qualifiers, along with "descriptors" indicating which of the QC limits were exceeded, resulting in the assignment of qualifiers.

The component is being further developed to accomplish the following:

a. Aid the data validator in the process of assigning qualifiers on the basis of the lab quality control information linked to the data;

b. Aid the data user in the process of determining levels of data usability (for example litigation quality, screening quality, and unusable) on the basis of the quality control information linked to the data and the data standards to be applied, including;

    i. the ability to re-designate the data quality category by modifying the standards which apply for a particular application and data set;

    ii. the ability to carry in the data tables the data quality designation for each parameter, along with a link to the documentation of the rationale for the standards which resulted in that designation.

    iii. the ability for data system staff to describe additional data quality categories based on considerations yet unknown by easily modifying a set of sorting criteria.

c. semi-automate standard report production

Importing of laboratory QC information associated with data validation qualifiers will be encouraged throughout the Clark Fork Region on all data processed from this point forward. In order to handle data processed prior to development of the system, and to handle data yet to be validated under work orders and contracts already in place, the ability to handle data validation qualifiers and laboratory flags in lieu of actual laboratory QC data will be maintained.

Data in the DMS will therefore fall into one of four categories: On the lowest level "0" will be data which has not been associated with any QC data. Data associated with laboratory process flags will be designated level "1". Data subjected to a formal QA/QC review process will be designated level "2" or level "3", depending on whether the process was conducted by a PRP contractor or an EPA/DHES contractor. It must be emphasized that the four levels described here do not correspond to levels of quality; rather, the levels correspond to how much is known about the quality of the data.

The DMS QA/QC system for inorganic chemicals is implemented in the Data Management System through the interaction of three tables (see the Clark Fork Data Management System Coding Specifications for detailed descriptions of the tables discussed below):

1. CFRICO - Inorganic Chemicals.

   In addition to analytical results, data validation qualifiers are carried for each analyte.

   Additionally, a Level A/B designation is carried for each sample.

   A "BATCH" code is carried which is the key to a record in the CFRICQ table containing laboratory QC information relating to the analytical results.

2. CFRICQ - Inorganic QC

   The CFRICQ table carries information reported by EPA CLP labs on forms II through XI, and related information necessary for formal data validation. Additionally, a coded "descriptor" is carried which indicates when a particular QC test result falls outside a specified limit.

3. CFRICL - Inorganic Limits

   The CFRICL table carries the standard limits specified for each QC test. If a particular set of limits is altered, the new limits are carried, referenced to the administrative record.

The system is currently set up to allow for qualifiers, descriptors, and numerical values to be entered manually or imported from a table of like structure. The system could feasibly be used during the data validation process to assign descriptors and qualifiers on the basis of the QC values and limits set.

4.3.1.4 DMS Implementation of Data Assessment

NOTE: Procedures for handling data assessment information in the data base are being developed. The discussion which follows relating to data assessment should be viewed as tentative.

Each record in the DMS may contain information which allows the user to differentiate between levels of quality of data, and therefore use only that data which meets standards necessary for a particular query. Standards can be adjusted at the time of the query.

Analytical Results

Physical and chemical measurements are recorded in several observation tables, grouped as normally reported by laboratories. Results are recorded in individual data fields. The analytical value is entered first, followed by CLP laboratory concentration flags, followed by data validation qualifiers. Additionally, a field is provided for recording the Level A/B

designation assigned to the sample. Codes identifying the "batch" and "case" associated with each sample are entered into "BATCH" and "CASE" fields. The CFRICQ (QC) table contains the qualifiers, descriptors and values resulting from the data validation process.

This approach provides maximum flexibility in utilization of the data. For example, data may be sorted on the basis of the level of quality analysis to which it has been subjected. Further, data which has been subjected to a particular level of quality analysis can be sorted on the basis of the qualifiers assigned. Further yet, data for which lab QC data has been imported can be grouped according to the QC test resulting in the assignment of the qualifier or according to the QC test result. Maximum flexibility is allowed by providing the means to sort data on the basis of quality standards (QC test limits) which can be adjusted on the spot, thus giving project personnel maximum control over the data set which governs their actions and plans.

4.3.1.3 Data Integrity

A number of different errors can occur when reporting, coding, and entering data into a complex system. Certain features of the DMS attempt to minimize errors and maximize the reliability of data.

The DMS contains an integrity rule subsystem. This detailed subsystem checks the integrity of each attribute and relation.

The DMS incorporates an entity integrity rule that checks the uniqueness of the record key as it is being entered and then prevents the modification of the key during editing. Also during entry, the system attempts to find a parent record (if applicable) and provides an error message detailing the fact that such a parent does not exist. The system will prevent data entry of the record until a correct key is entered, or until the necessary record is entered into the parent table.

The DMS incorporates referential integrity rules that verify that a field that uses coded values only contains values that exist as primary key values in another relation that defines the domain of legitimate field values. For example, the system will check the Records and Documents Management (RDM) table to make sure that a value in a DOCUMENT field of any table identifies a document in the RDM table that does indeed exist. The Rules programs also check codes used in fields against the list of allowable codes stored in the dictionary files PAR, RDX and TAX. These checks include testing for valid initials and organization codes, analysis methodologies, spheres, and parameters.

The DMS provides a database dictionary that defines the sets of domains and relations. This makes it possible to quickly modify the structure of the database by adding or deleting relations, and also to share domains between relations and databases. A domain consists of a domain name, a fixed non-empty set of domain values, and an ordering indicator. This dictionary also verifies that every domain and every named relation in a given database had a unique name. A Rule dictionary guarantees that an attribute consists of an attribute name and a domain name, and that the attribute identified by an attribute name is defined on the domain identified by the domain name.

The DMS structure guarantees that all domain values for a given domain are of the same data type, that attributes of a given relation have unique names, that every relation has exactly one primary-key.

The Rules are run in batch mode, sending a list of errors found to a table called BAD. These errors can be printed or filed from the table using Knowledgeman/2 commands if desired. Once a record has successfully passed Rules tests, the field RULES is marked "True", and the date of the test is stamped on the record. This documents that the record has been checked.

When a record is edited, the RULES field is automatically marked false again, to be re-checked the next time Rules are run.

4.3.2 Security

Security for the DMS employs features of Knowledgeman/2, the data management software utilized, and Novell Netware, the Local Area Network software utilized. Access to the system is limited to those having been assigned passwords. Access may be further controlled through the assignment of access rights, which can be limited to read or write access to individual tables, records within assigned tables, or even fields within assigned records.

4.3.3 Backup Procedures

The DMS is equipped with an IRWIN 64 MB streaming tape backup system. Backup is performed on a routine scheduled basis as well as just prior to and following major system modifications. Daily and weekly backup tapes are stored on site in a locked metal filing case. Monthly backup tapes and backup tapes relating to major system modifications are stored in the Bureau of Records and Statistics safe, located in the Cogswell Building.

A typical backup schedule is as follows:

Month 1:	Full backup for permanent storage - Tape labeled with mm/dd/yy. Full backup - Tape #M01
Daily (optional):	Backup after any significant file changes - Tape #W01 - DO NOT overwrite existing backup sets
Week 1 (optional):	Backup of all files changed since last backup -Tape #W01 -DO NOT overwrite existing backup sets
Week 2 through 5:	As described for daily and Week 1 - Tapes #W02 through #W05
Month 2 through 6:	As described for Month 1 - Tapes #M02 through #M06
Daily & Weekly:	As described - Overwrite Tapes #W01 through #W04
Month 7:	Full backup for permanent storage -Tape labeled with mm/dd/yy

Repeat procedure for Months 1 through 6 overwriting Tapes #M01 through #M06

An additional level of protection may be added if deemed necessary as follows:

1. Make weekly backup of changed files mandatory rather than optional.
2. Make full backups each week rather than changed files only.
3. Monthly backup as described.
4. Semi-annual backup for permanent storage as described. Upgrade to quarterly if deemed necessary.

Documentation is filed with each tape, recording the date and extent of each backup as well as the date and extent of any file restoration completed using the tape.

4.3.4 Document Library

A field is provided for each record in the DMS to record a code for the best reference for additional information regarding that record. The document referenced for a record in the SURVEY (CFRSU) table might be the work plan describing the survey effort resulting in the data collection. The document referenced for a record in the STATION (CFRST) table might be the field book describing the location and features of each station. Field notebooks describing the conditions regarding each sample might be referenced for records in the SAMPLE (CFRSA) table. Lab data obtained in machine-readable format is commonly referenced to the diskette from which the data was imported.

Document descriptions (title, author, abstract, etc.) are contained in the RECORDS and DOCUMENT MANAGEMENT (EISRDM) table, where a location code for each document is also stored. The document may be stored on site, in the Montana EPA Office, in the MDHES Solid and Hazardous Waste Bureau office, at the MSL GIS facility, or any other readily accessible location. In addition to the DMS document reference number, the system stores the library identification number of the off-site library in which the document is stored, if applicable. In this way, the ability to obtain a document is provided while duplication of effort is reduced to a minimum.

Information relating to documents not actually referenced to a particular record but which provide useful information regarding data in the system is also maintained in the system. A search path to such documents is provided through the RECORDS AND DOCUMENTS CLASSIFICATION (EISRDC) table. This table provides the ability to query the system for documents relating to a selected subject, document type, data type, sphere, units, activity, and related survey.

4.4 CLARK FORK GEOGRAPHIC INFORMATION SYSTEM

The Clark Fork GIS serves to manage spatial data sets and allows for processing and analysis in support of the CFDS. Formal QA/QC procedures for the use of GIS in Superfund Site projects are undergoing development within the EPA and will be incorporated into the Project Plan as they become available. For this project, the database design will provide the framework for QA/QC practices conducted on spatial data sets.

4.4.1 GIS Target Database Design

The Target Database Design concept provides a GIS database-management tool that allows for QA/QC practices to be incorporated into the design itself. The structure puts into place a series of increasingly stringent standards that a data set must pass through to proceed to an inner ring of the target. The center or bulls-eye of the target is be the area or database of the highest quality data; that is, data that passes all the tests for quality assurance.

The Target Database Design consists of three rings, including the bulls-eye. The outer ring contains data as they come from any outside source, magnetic or manually encoded. It still requires a paper trail that documents the data's lineage; i.e. source manuscript, acquisition scale, purpose, etc.. As data move through the database rings, the documentation for each coverage is assembled. Database documentation is described in the following section.

Movement of the data to the middle ring requires an inspection of the topologic accuracy for features involved in the data set or coverage. This process requires an overlay comparison of the manuscript source and scaled output of the coverage (EDITPLOT). If the data are thematic; that is, compiled on to a base map from other sources, the original manuscript source should be made available. The coverage would then be edited to incorporate any changes in the features to bring it into compliance with the standards in place. The coverage must also

be entered into the data dictionary before it moves to the middle ring.

To finally bring the coverage into the inner ring of the database, attributes associated with the features must be inspected to assure quality. This inspection may be done using overlay comparison of shaded maps, map labeling, or inspecting tabular list of the feature attributes. A sampling procedure may be used if multiple titles or quadrangles must be inspected, as long as it is well documented and statistically sound.

The Outer, Middle, and Inner Rings are described in detail below. Names in parentheses are the actual directory names for each ring. The basic database directory structure is depicted in Figure 8 - Clark Fork GIS Database Design.

Outer Ring (WORK)
Description: This directory is a work area for the input, editing, and analytical work for the GIS. It will also contain work spaces for various projects and system users.

User Access Rights: The GIS Coordinator and the GIS Programmer/Analyst will have "write" access rights to the WORK directory. Other Clark Fork Superfund project related staff (e.g., project managers, contractors, EMSL-LV personnel) will be given "write" access rights to this directory on a project by project basis.

Standards: The data in the WORK database represent the least verified data. This level is where coverages are created (e.g., by digitizing, by conversions), edited, and where verifications are performed in order for data to move to the next highest level.

Middle Ring (GIS-1)

Description: Coverages at this level are judged to be "spatially correct."

User Access Rights: The only staff person with "write" access rights to the GIS-1 directory is the GIS Officer at the Montana State Library. Other users will have access rights to copy necessary data and coverages from this directory into their own work spaces.

Standards: To enter this directory, the spatial data must:

- have topology created (using the CLEAN and/or BUILD commands);

- have been verified to be 100% spatially correct (no missing or extraneous features are in the coverage and all features are within 1 line width of the correct location) by using check plots (displaying feature locations, nodes, pseudo nodes, and dangling arcs);

Inner Ring (GIS-2)
Description: Data coverages in the Inner Ring are judged to have both "spatial and attribute data" correct.

User Access Rights: The only staff person with "write" access rights to the GIS-2 directory is the GIS Coordinator at the Montana State Library. Other users have will have access rights to copy necessary data and coverages from this directory into their own work spaces.

Standards: Data updates or new coverages created in project work spaces as the result of GIS techniques must work their way back into the inner ring through the QA/QC procedures. Once new data has been through the QA/QC process, the GIS Coordinator may then add them to the GIS-2 Directory.

To enter this directory, the coverage must have:

- the proper attribute fields in the feature attribute tables;
- passed through the Middle Ring of the database;
- had attribute data verified to be in the 99th percentile of accuracy compared to the source data.

A variety of methods are available for the attribute data verification. Briefly, these include:

1. **Validity Tests:** check data values to determine if they are valid for a particular feature;
2. **Range Tests:** check data values to determine if they are within permissible ranges for the feature;
3. **Consistency Tests:** test the consistency of values between two attributes; and,
4. **Probability Tests:** test the statistical likelihood of a value occurring for a feature.

These checks may be run using computer programs developed by the GIS staff. There are a large number of statistical programs which may used for data verification.

A computer program will be run on any data converted from the DMS to compare the records received from the DMS with the records contained in the ARC/INFO map coverage .AAT or .PAT to check for discrepancies.

4.4.1.1 Data Update

Databases are not static. When information in the data base becomes obsolete, and the need for that data still exists, the database can be updated. Data update can usually be handled by the same software and hardware that performed the initial data entry. When new data are added to a map coverage, the entire coverage usually needs to be reprocessed and verified as if it were a newly digitized data set. The same verification procedures and movement through the target database will be performed on the both the geographic coordinate data and the attribute data depending on the nature of the update. To re-iterate the process of data movement through the target database, new data or updates to the database enter the outer ring (WORK directory). In this ring, the coverage is entered or updated in the data dictionary. When the spatial accuracy is verified, the coverage is transferred to the middle ring (GIS-1). Data that resides in the middle ring has topology built and the spatial accuracy has been verified.. When the attribute data have been verified, the coverage is then moved to the inner-ring (GIS-2). Coverage that reside in this directory have had both spatial and attribute data verified.

4.4.1.2 Spatial Data Storage Method

Spatial data within the GIS will be stored as ARC/INFO "coverages" with associated attribute information stored in INFO. The coverages will be stored using Universal Transverse Mercator coordinates using UTM zone 12 (UTM zone 11 will be used where applicable). Geographic coordinates and units of measurement are meters with 5,000,000 meters subtracted from the Y-axis or northing.

The coverages in the GIS are stored in Universal Transverse Mercator (UTM) projection/coordinates. Using the ARC/INFO PROJECT command, these coverages can be transformed to a variety of other projections. Data imported from the DMS are converted from either Latitude/Longitude or State Plane Coordinates to Zone 12 UTM coordinates using the ARC/INFO PROJECT command.

Much of the data for the Clark Fork River GIS come from Anaconda Mineral Company maps.

These maps use an Anaconda Coordinate System (ACS). EMSL-LV has provided a coordinate conversion program to convert from ACS to UTM. This program converts (x, y) coordinates (in feet) specified in terms of the Anaconda Coordinate System (ACS) into Universal Transverse Mercator (UTM), Zone 12, coordinates in meters. The transformation used is conformal (angle-preserving) and is based on a least-squares adjustment using three control points.

When performing ARC/INFO functions on coverages that would alter the data, the standard procedure to be followed would be to create a new coverage of the altered data. In this way, if the new data are inaccurate, the function was inappropriate, and a different function needs to be performed, the original data are left intact. Each new coverage will be given a sequential number related to the coverage name so that the most altered generation of a specific map coverage may be readily identified. If appropriate, the procedures used to derive new coverages may be stored as ARC Macro Language programs so that the coverages can be deleted and then re-created when needed. This procedure may be followed to save disk space.

4.4.2 GIS Data Documentation

GIS data documentation provides information about the history and format of data in map coverages. This documentation process applies both to base coverages as well as derived coverages. There is nothing inherent in the storage of map coverages which indicate the accuracy of their source data. There is also nothing inherently stored in the coverages which indicates what the data codes mean or how they can be use. It is therefore vital that coverages have external documentation to make the use of the data possible, and to help prevent inappropriate applications of the data.

The data documentation has three functions:

1. To document the history of the data prior to their entry to the GIS.

2. To document the data as they reside in the system and to document how the data have been altered.

3. To provide explanations of the data attribute codes.

These three functions are performed by two programs:

- the Data Dictionary in INFO which provides documentation of the data history and explanations of the attribute codes

- COVDOC.AML which provides documentation of the coverages as they reside in the GIS database

The Data Dictionary creates a set of related data files which contain the documentation information. The COVDOC.AML creates a series of text files which contain the initial documentation information and subsequent updates. These data files (from both programs) are stored on the GIS computer at the MSL. In addition, print-outs of the data documentation files created by these two programs will be stored by the MSL. The data dictionary code explanations will also be published in the *GIS Resource Document*.

4.4.2.1 Data Dictionary

The data dictionary will document every coverage in the Clark Fork database. It will be created using the INFO database management system. The basic structure is modeled after "Data Dictionary" described by Dean R. Anderson in the 1988 ARC/INFO Training Course Technical Handout Manual, and incorporates enhancements made by the Washington State

Department of Natural Resources.

The data dictionary consists of three primary files and several support files. The three primary files are the layer definition file (LAYER.DEF), the source description file (SOURCE.DEF), and the item definition file (ITEM.DEF). The layer definition file describes the nature, content, and location of every coverage on the system. The source description file details the method used to create the coverage, describes the source material, and points to the location of its QA/QC records. The item definition file describes all of the data items in every coverage.

The layer definition file can be linked to the item definition file and source definition file to provide complete information on any coverage and its data items. Standard input forms and reports are available for the three major files to expedite data entry and provide automatic reports of the file contents.

The primary files are supported by several subsidiary files which provide the links among them and explanations of the codes contained in them. *Appendix I - Data Dictionary Files, Forms, and Reports*, contains a list and explanation of all of the files in the Data Dictionary. It also contains copies of all the input forms and reports which are available.

4.4.2.2 COVDOC.AML

In addition to the data dictionary program described above, the GIS will use an AML program, COVDOC.AML, which employs the several ARC/INFO functions to document coverages. The COVDOC.AML was developed to provide a 'snapshot' of a coverage's current condition. It is intended that the COVDOC.AML be used following final processing of the coverage. The AML creates a system file that will be edited to include information not generated automatically. Subsequent use of the AML will add new information to the documentation file if the coverage is altered. Data recorded in the file includes: coverage name and description, a brief history of the source documents from which the coverage was generated, and the information provided by the ARC commands DESCRIBE and LOG. Additionally, the names of all associated INFO files and the item definitions for the applicable feature attribute tables are included. *Appendix J - Sample Printout of COVDOC.AML* contains a sample COVDOC.AML printout for a coverage.

4.4.3 GIS Data Entry

The GIS uses data input function computer hardware (physical devices) to allow the input and editing of data which is not yet in digital format; computer software (programs) to control that hardware; and software to convert existing digital data from "foreign" databases into formats compatible with the management system of the GIS. Hardware for data input commonly consists of a keyboard for entering data from printed documents and tables; a digitizer or scanner for converting geographic coordinates from maps into digital form; and a tape drive to read data tapes written by other computers.

4.4.3.1 Manual Data Entry

Map digitizing is one of the most common methods used to input spatial data into a GIS. This section documents the map digitizing/editing procedures to be used in the Clark Fork GIS. The ARCEDIT procedures outlined here may also apply to other digital data that has been input to the system using methods outlined above.

Prior to digitizing, the map will be prepared--registration marks will be identified, labels assigned to features, and problems such as missing lines, edge matching between map sheets, or assignment of proper code values will be resolved. A plan will be developed to determine how the job is to proceed so the data will be as useful as possible, all values will be properly

encoded, and so mistakes are minimized.

The interactive ARCEDIT software is used for map digitizing. When digitizing, the operator will enter codes which indicate what the feature being digitized represents--such as a boundary, road, or section corner. These entries are crucial for the linkage of the attribute data to the proper geographic location and feature.

The Clark Fork GIS Project uses a Calcomp 9100 digitizing pad that has a resolution of .001". Contractors performing digitizing for the Clark Fork Superfund project will use a comparable digitizing pad with .001" resolution.

Spatial data coordinates may be entered via the computer terminal keyboards in ARCEDIT in order to add, update, or create new map coverage features. Features created or updated in such a fashion would be subject to the same verification and editing procedures outlined in the GIS Target Database Design - Section 4.4.1 above.

Tabular attribute data may be entered via the keyboard in INFO using an INFO Form (for standard repetitive input) and using the UPDATE command. Data entered in such a fashion is subject to the verification procedures outlined in Section 4.4.1 above. When possible, large amounts of manual data input will be performed by two separate individuals each typing in the same data. The two data files will be automatically compared and any discrepancies will be identified for editing.

4.4.3.2 Converting Existing Database Files into ARC/INFO Coverages

The GIS staff produced an ARC Macro Language (AML) program as an automated method for creating ARC/INFO point coverages with associated attributes from ASCII files. Such ASCII files are easily produced by most database management systems, but they must conform to a very specific format before they can be directly imported into the GIS using the AML program. This file format is described in *Appendix G - Work Order Data Specifications, Attachment B.*

Converting foreign data into arc or polygon coverages is more complicated than creating point coverages. Much depends on the current format of the spatial data--what coordinates are stored, their format, the extent of duplicate coordinates stored, etc. Each conversion will be handled on an individual basis. Conversion of either type of data will use the Arc GENERATE command to create the initial coverage; ARCEDIT to CLEAN and BUILD the topology, and INFO commands (ADDITEM, JOIN, etc.) to create the related INFO attribute files.

4.4.4 Verification of Acquired Data

Data input to the Clark Fork GIS may come from a variety of sources. This section documents the basic procedures and requirements that will be employed to convert and input data. The idealized flow of data through the Target Database is depicted in Figure 9. This diagram illustrates a coverage being compared to the original data (both map and attribute) in order for the coverage to move through the database to the inner ring.

Data collected by contractors for EPA is funneled through EPA to the Clark Fork Data Management System. Data that have entered this system will have undergone a QA/QC procedure established by EPA and their contractors.

Much of the environmental data to be entered to the GIS will come from the DMS. These data will retain, in the form of documentation, the quality of the data as determined by project managers' requirements and the DMS query process. All the data that enter the GIS will move into the Target Database Design. It will be the responsibility of the project manager to work

with the DMS Database Administrator and the GIS Coordinator to determine the appropriate use of those data sets transferred from the DMS to the GIS. The level of use will, in turn, determine to what level of accuracy the spatial component of the data set will be required to meet. Project managers must realize that spatial coordinates received from the DMS may have not previously been checked against the manuscript source, and the quality of the data is unknown. Depending upon the desired use of the data, a varying amount of data quality procedures may be applied against the data set.

For digital map data obtained from EPA and the manuscript is available, the data are verified according to the Target Database procedures outlined above, and stored in the appropriate target level of the database.

For digital map data that is obtained from EPA contractors or PRPs and their contractors, the following is required:

- Manuscript description and documentation

- Data dictionary documentation

Map check-plots will be supplied to the contractor by the GIS for the contractor to check for spatial accuracy. If this procedure cannot be followed, the GIS will attempt to obtain the original manuscript for in-house checking. Data from other digital-data sources, such as the USGS, the spatial data loaded into the system will be checked against the manuscript map if available. The data will move through the Target Database as described above Section 4.4.1 - Target Database Design.

4.4.5 Security

The GIS employs a variety of security features found in Primos[1] (the Prime computer operating system), ARC/INFO, Log-Time, and database design concepts to guard against the accidental or intentional alteration or erasure of data. Security measures are in place to protect the data and programs on the Clark Fork GIS. These measures include:

- login accounts and IDs will be issued only to authorized users (see *Chapter 5: Access Guidelines*);

- the use of login passwords to prevent unauthorized entry to the system;

- the Log-Time Accounting Program will record any unauthorized or failed login attempts;

- the master data sets (**GIS-1** and **GIS-2**) will have Access Control protection to prevent the intentional or accidental erasure or alteration of data. The only staff person with "write" access rights to the Level II and Level III directories is the GIS Coordinator at the Montana State Library. Other users have will have access rights to copy necessary data and coverages from this directory into their own work spaces;

- non-Superfund users on the system will not be able to gain access to the EPA or Superfund disk partition nor will they even be able to list it; and,

- remote lines and users on the Prime will be required to give both a user-id password as well as a "system password" to be able to log into the computer. This method adds

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[1] For a more complete explanation of access control and security procedures see Prime's System Administration Volume III.

an additional level of security to the remote lines.

4.4.6 Back-up Procedures

The following back-up procedure is in place for the Prime minicomputer at the Montana State Library. Incremental (any file that has been opened since the last back-up) back-up tapes will be made on Monday through Thursday. On Friday afternoons (or the last day of a work-week), full back-up tapes will be produced for Master File Directory (MFD) 1 disk partition. Included in the full back-up procedure will be the MFD 0 partition if new programs or data were added or altered. Both MFD 0 and MFD 1 will be backed-up on the first Friday of each month. This full back-up set of tapes are stored at a secure off-site location for a period of one calendar year. A full set of data back-up tapes for the data will be provided to the Region VIII GIS in Denver every quarter.

4.5 CONFIDENTIALITY OF DATA

The Clark Fork Data System operates under the provisions of *Chapter 5 - Access Guidelines* developed by the Clark Fork Technical Working Group which states that "[a]ll data in the system that is not considered confidential or proprietary will be available to all users." Issues of confidentiality of data contained in both the DMS and the GIS are also governed by the Memorandum of Agreement between the Department of Health and Environmental Sciences of the State of Montana and the United States Environmental Protection Agency Region VIII (see *Appendix K - Memorandum of Agreement*). In addition the GIS and the DMS have specific regulations and procedures regulating the confidentiality of data. These specifics are discussed below.

4.5.1 Clark Fork DMS

Two levels of protection from the release of confidential data are provided:

a. data carried in the usual data tables can be flagged as confidential. A comment can be provided further describing which fields are confidential and which can be released. In this case, the direct action of the individual retrieving the data from the system is necessary to exclude the confidential data from any query.

b. data can be placed in special tables designated for confidential data only. Access to the confidential tables can be limited through data encription and password protection.

4.5.2 Clark Fork GIS

The Natural Resource Information System is mandated by the Montana State Library Laws (90-15-304) to "(1) Except as provided in subsection (3), the library shall make information from the natural resource information system available to local, state, and federal agencies and to the general public. (2) The library may establish a fee system for information requests in order to cover the costs of providing requested information. (3) If necessary, the library shall establish procedures to protect confidential information in the possession of state agencies." This language matches the access guidelines outlined in Chapter 5. In essence, while data managed by the NRIS is to be made available to the public, NRIS does have the ability to protect confidential data. The procedures to protect the data are those described in this chapter and in *Chapter 5 Access Guidelines.*

CHAPTER 5 - ACCESS GUIDELINES

There is a need to identify guidelines for user access to the Clark Fork Data System (CFDS). These guidelines are needed to address the following types of questions:

- Who should have direct access to the computer data base?
- What means for accessing the CFDS are possible?
- How should priorities be set for data requests?

The actual operational details for system access are addressed in *Chapter 4: Data Administration.* Section 4.5.5 - Security provides a specific explanation of system security related to users. This chapter focuses only on the general user access guidelines.

5.1 ASSUMPTIONS

There are several general assumptions which are basic to development of access guidelines. These assumptions are identified below.

- All considerations of access refer to the entire Data System which is comprised of the Data Management System maintained by MDHES and the GIS component of that system located at the State Library.
- A priority of access will be given to Clark Fork Superfund-related requests over other Superfund site requests and non-Superfund requests.
- All data in the System that is not considered confidential or proprietary will be available to all CFDS users.
- Data will be provided in a timely manner and in a form that meets, as much as possible, the needs of the requestor.
- To the extent allowed by copyright laws, computer models and software packages should be available to users interested in performing their own analyses on system data.

5.2 RECOMMENDATIONS

Guidelines for access have been developed for user groups as described below.

I. Clark Fork Superfund project managers and support staff.

- User accounts will be provided to this group.
- Contractors will have the same access as project managers only if the project manager authorizes such access.
- This group of users will have direct hands-on system access.
- Requests for simple data queries or graphical products can be directed to the GIS Officer or the Data Management System Manager.
- Requests for all analytical work or data base analysis must be directed to the Technical Working Group (or a designated sub-group) for evaluation and establishing

a priority for completion.

II. Potential Responsible Parties (PRPs)

- No user accounts will be provided.

- No direct hands-on system access will be provided.

- Requests must be coordinated with appropriate Superfund site project managers.

- PRP requests will have the same access priority as project manager requests after approval by the project manager.

- Requests for simple data queries or graphical products can be directed through the Superfund site project managers to the GIS Officer or the Data Management System Manager.

- Requests for all analytical work or data base analysis must be directed through the Superfund site project manager to the Technical Working Group (or a designated subgroup) for evaluation and establishing a priority for completion.

III. Other Users

- User accounts may be provided on a case-by-case basis for log-in to non-Superfund areas of the Data System.

- System access will only be provided if such access will not interfere with the needs of the Clark Fork Superfund program as determined by the Technical Working Group (or a designated subgroup).

- All requests for access or system products must be directed to the GIS Officer or the Data Management System Manager for action or, if necessary, referral to the Technical Working Group (or a designated subgroup) for evaluation and establishing a priority for completion.

5.3 GENERAL GUIDANCE

- If questions arise concerning a request which does not fit into the above categories, the Technical Working Group (or a designated subgroup) shall have final decision-making authority.

- A regularly updated listing of data in the system will be maintained and be available for distribution to interested users upon request.

- Each request for access to the data will be responded to in the order in which it was requested. If a short time is needed to respond to a request received after a more time-consuming request, the short request may be completed first. Experience with the system will be gained before attempting to establish a formal priority response system.

CHAPTER 6 - USER SUPPORT AND TRAINING

6.1 CLARK FORK DMS

The Clark Fork Data Management System is staffed as necessary to provide limited "service bureau" access to the data for project officers and contractors associated with the project. The Data System administrator is trained in the use of Knowledgeman and the Environmental Information System. Routine queries and requests for limited analyses are handled by the system administrator.

The Environmental Information System was adopted for use in part because it contains a well developed user interface which provides for access to and effective use of the System by persons with limited training. The System will be made accessible to project officers within the Montana MDHES through a Novell LAN. Limited training in the operation of the System through the DMS user interface will be provided to those desiring to utilize the System directly. The amount of training needed is minimized through the use of the DMS user interface.

The DMS contains a View subsystem which allows for the creation and permanent storage of queries which are run on a routine basis. The queries can be created by the system administrator and made available to project officers and other system users through a menu interface.

The DMS contains a report generation facility which facilitates the layout of report formats including report, page and group headers, footers, and details. The reports can be created by the system administrator and made available to project officers and other system users through a menu interface. The DMS also contains a menu driven facility to assist in the creation and modification of report layouts with limited programmer assistance.

Additionally, Knowledgeman contains a Standard Query Language (SQL) facility which is a recognized standard in the database field. This facility can be used to easily obtain listings on an ad-hoc basis with minimal training.

6.2 CLARK FORK GIS

The GIS project addresses the need to supply training and support in a variety of ways. The GIS project can arrange to have on-site ARC/INFO courses for up to ten people with instructors from ESRI. The price for on-site training is a substantial savings over sending people to ESRI's California headquarters for training. Arrangements can be made to help underwrite the training costs by opening attendance to other ARC/INFO users in the region. Classes available from ESRI are:

- ARC/INFO Training Course
- Introduction to Database Design
- Cartographic Production
- Geographic Analysis
- Applications Programming (Arc Macro Language)
- ARC/INFO System Programming
- Systems Administration
- Processing Techniques
- Triangulated Irregular Network

In addition to the ARC/INFO classes offered by ESRI, EMSL-LV can provide specific GIS training opportunities to the Clark Fork staff. Also, as the EPA Region VIII GIS develops, there will be training offered at their facility. Also in Denver, the USGS offers GIS courses

at its training center. Besides these government opportunities, there are a wide variety of specialized course offerings from university and private sector facilities around the country.

The GIS staff maintains a library of materials from these courses as well as complete set of software documentation. Other books, articles, and reference material are also available from the GIS staff.

The GIS project publishes the *Clark Fork GIS Resource Document* which serves two purposes: 1) as an educational resource about GIS; and, 2) as a reference manual for system users and those requesting GIS products. The document is designed to provide information to both regular "hands-on" GIS users as well as those who make only occasional requests of the system. Updates and additions to the Resource Document will be produced approximately every 90 days. Included in the Resource Document is a comment page to elicit feedback to guide the frequency and content of the updates, additions, and revisions.

Along with the more formal training support (e.g., classes and documents) the GIS staff act as consultants to assist project managers and other Clark Fork Superfund staff as well as contractors and PRPs in their GIS pursuits. The GIS staff has and continues to take formal training courses for ARC/INFO and ERDAS. In addition, the staff makes a strong effort to remain current in fields that relate to GIS applications and techniques (e.g., geography, cartography, spatial analysis, computer science, and GIS) by reading journals, attending conferences and workshops, and maintaining professional contacts nationwide. All of this activity increases the ability of the GIS staff to supply support and advice to Superfund project staff.

The ARC/INFO macro programming language (AML) provides a means for the GIS staff to develop application specific programs to support project managers. These application programs make the GIS more accessible, easy to use, and support project managers in their work tasks.

CHAPTER 7 - GIS APPLICATIONS AND DATA ACQUISITION PLAN

7.1 OBJECTIVES

To help identify the ways the GIS could aid the Clark Fork Superfund project managers a user survey was conducted during the summer of 1988. The survey was administered by the Clark Fork GIS staff to project managers at the Montana EPA and the Montana Department of Health and Environmental Sciences. The information collected in the survey--including follow-up interviews--combined with interviews conducted by EMSL-LV staff and contractors form the basis for the development of the GIS application descriptions and the establishment of priority guidelines. The complete draft report of the survey is located in *Appendix K - GIS User Survey.*

The respondents in the survey were asked to identify the specific objectives/goals they hope to achieve by using the GIS. These objectives illustrate a wide variety of expectations and potential use and support of the system. The objectives ranged from specific application results to very general desires. The common objectives appear to be the following:

1) the desire to better define the nature and extent of the contaminants at the sites;

2) identification and assistance in planning future data collection efforts;

3) help in managing and accessing site data; and,

4) evaluation of potential remedial actions.

Based on the *User Survey*, the *EMSL-LV Work Plan Version 2.0* (Appendix L), the objectives outlined above, and the meetings with project managers, a variety of GIS applications, products, and required data themes have been identified. These applications are related to the Priority Guidelines outlined below.

7.2 PRIORITY GUIDELINES FOR GIS APPLICATIONS

GIS applications will support forward planning efforts, State lead sites (e.g., Silver Bow Creek), oversight/review functions, Fund Lead RI/FS, or special Basin-wide applications (e.g., PRP information management). Because of the potential for numerous GIS applications to be required by Clark Fork Superfund project staff, it is necessary to establish criteria for priority ranking. The following criteria are proposed as guidelines to assist in establishing these priorities.

- Date application is needed as indicated in Clark Fork Superfund Master Plan, SPMS (commitment to EPA Headquarters), or SCAP (budget)

- Availability of information (data)

- Feasibility of producing desired product

- Ability of GIS to produce a product that cannot be readily produced by manual methods

7.2.1 Proposed Ranking of GIS Applications

Based on these criteria a general ranking of GIS applications in the Clark Fork basin has been proposed. The highest rankings are intended to meet or fulfill each of the above criteria to the maximum extent. The proposed ranking is subject to review and comment by all project

are outlined below. It must be acknowledged that these may change over time, some may be dropped, and new ones added. The GIS Technical Working Group will review these application on an ongoing basis and will be responsible for modifying and updating this plan.

The various long-term analyses and products required for the Clark Fork Superfund sites are identified in the following section. The applications section is divided into six project sections corresponding to the Upper basin and the NPL sites:

- Basin-wide (affects all NPL sites in the upper Clark Fork Basin),
- Anaconda,
- Silver Bow Creek,
- Butte Addition,
- Milltown Reservoir, and
- Montana Pole.

For each applications section the operable unit is identified, the application objective is stated, the application is described, and any pertinent discussion is included. Since much of the data are common to several applications and have uses across operable unit boundaries, the data to be acquired for the applications are described at the end of the section. Data acquired for the DMS and the GIS will follow procedures outlined in *Chapter 4 - Data Administration* and in *Appendix F - Work Order Data Specifications.* The map on page ? provides a graphic summary--by site and operable unit--of the data to be acquired, the existing data themes, and an indication of the data themes common to more than one operable unit. *Appendix N - Current Data in the Clark Fork Data System* lists the data that are currently in place on both the geographic information system and the data management system.

7.3.1 Basin-wide

Many of the GIS applications affect more than one NPL site or operable unit in the Upper Clark Fork Basin. These applications are described below.

7.3.1.1 Applications

1. Development of Base Map Data for the Upper Basin

Operable Unit: Clark Fork-wide

Objective: To create base map coverages for the Upper Clark Fork basin that will then be available for a variety of applications.

Description: This data creation process is underway and will continue as needed. Already available on the system are:

- 1:100,000 USGS Digital Line Graph data for transportation, hydrography, miscellaneous transportation, and railroads. These coverages were acquired and processed by EMSL-LV and transferred to the GIS. The GIS staff finished the edgematching and data verification processes. These coverages are now available for use.

- USGS Geographic Names Information files were acquired and loaded into the GIS by the GIS staff.

- Digital data sets for county boundaries were acquired and converted to ARC/INFO coverage by the GIS staff.

- Montana Natural Heritage data (element occurrences of endangered plants and animals) for the Upper Clark Fork and Blackfoot drainages

- Montana Rivers study data for the Butte North 1:100,000 quad were acquired and loaded into the system by the GIS staff.

Base data will continued to be acquired and input to the GIS as they are requested by project managers or needs are identified. This process will allow the database to evolve and be refined. These data will support and be used with nearly all of the applications identified in the following sections. An additional data set that needs to be acquired is the US Public Land Survey (township/range) for the Upper Clark Fork basin.

2. Support of Waste Repository Siting

Operable Unit: Clark Fork-wide

Objective: To support the mine waste repository siting process.

Description: ARCO is in the process of identifying potential sites for the locations of repositories for mine wastes removed from the Clark Fork NPL sites. They have completed the first step in the process: a primary exclusion process that eliminated areas based on "fatal flaw" criteria. ARCO is now (May 1989) collecting data for the second phase of the siting process. The Natural Resource Information System (NRIS) and the Montana Natural Heritage Program (NHP) have and are supplying data to ARCO. The GIS supplied a map displaying NHP data to accompany a NHP report. The locations of the potential waste repository sites (those that passed the first cut) have been input to the GIS as a coverage.

The GIS can provide support in the repository siting process to ARCO and other parties in a variety of ways:

- Data input (through conversion of data sets) and subsequent ARC/INFO coverage creation (e.g., additional Natural Heritage data, additional Montana Rivers Study data, etc.)

- Transfer of existing data sets and coverages (e.g., base map coverages identified in the above application)

- Various coverage overlay analyses

- Cartographic products

- GIS technical assistance to contractors

The Access Guidelines provide for access to the GIS for ARCO and its contractors. For this application, the Montana EPA Clark Fork Coordinator would serve as the project manager.

3. Management of Potentially Responsible Party Information

Operable Unit: Clark Fork-wide

Objective: Support the Potential Responsible Party (PRP) identification process by automating a portion of the current process.

Description: Land ownership and operation and management of mining activities in the upper Clark Fork basin over the last 100 years is a complex relationship. Assignment of responsibility as either an owner, generator, or operator is required to identify PRPs. The determination of PRP status requires the management of large amounts of both spatial and temporal data.

In an effort to organize and sort information collected during PRP searches, the GIS will be used to assess complex relationships in a geographically extensive area where several owners, operators and generators have occurred over time. The intent of a responsible party search is to determine who the past and present owners, operators and generators are/or have been in order to assign liability for remedial actions necessary to prevent actual or potential releases of hazardous substances, contaminants or pollutants. Using the GIS, rationales for allocating PRP responsibilities (NBARS--Non-binding Preliminary Allocation of Resources) could be consistently applied.

The process that would be followed by the GIS to accommodate this need would be to maintain a base coverage consisting of:

- Political boundaries
- Transportation
- Hydrography
- Property boundaries
- US Public Land Survey
- Land-use

Superimposed on this base coverage would be several coverages that represent the time sequence of:

- Current or past ownership
- Current or past interest as a generator
- Current or past interest as an operator

Determination of viable PRPs could be accomplished by the following sequence:

- Develop a coverage of areas where contamination exists. Within each area delineated previously, assess an individual's responsibility based on past or present interest as an owner, operator, or generator.

- Identification would continue by eliminating entities that no longer exist or that do not have the financial resources to contribute meaningfully to the funding of remedial activities. Continued identification would proceed to determine which potentially responsible parties are viable.

- Non-binding preliminary allocation of responsibility (NBARS) could be supported by the GIS by determining the relative contribution to the problem by individual PRPs with respect to:

    - Percent of the contaminated area owned
    - Percent of the time the property was controlled
    - Percent of the volume/areal extent of the waste the PRP was responsible for

Some specific map products which could be produced include:

- Derived from the above coverages and land ownership data would be a series of map coverages that represent the time sequence of:

- Current or past ownership
  - Current or past interest as a generator
  - Current or past interest as an operator

- A map that displays locations (with ownership information) of unique chemicals/mineral sources and the locations (including ownership information) where occurrences of these unique chemicals/materials have been identified.

Along with the land ownership data, mining claim information may need to be collected and entered. An AML could then be developed that would facilitate the querying of the land ownership data and the graphic display of data. This AML would enable project staff--whether familiar with ARC/INFO or not--to query the data.

Discussion: There are several issues related to this application which will be resolved over the course of the project. The first of these regards the geographic scope of the database creation effort. It is suggested that the project be developed in stages with the Butte Priority Soils Operable Unit as the likely first effort. Over time a database of PRP information for the upper Clark Fork Basin covering all of the NPL sites may be constructed.

The exact data requirements for PRP management need to be defined by the staff responsible for the current PRP and NBARS procedure. The data collection and input for this application would be a major undertaking. The scope of the data collection effort would need to be clearly defined. Additionally, the database design--how to store the PRP information--would need special consideration. The database design will depend not only on the type of data to be collected and stored but also on how the database will be queried.

4. State Historic Preservation Data Management

Operable Unit: Clark Fork-wide

Objective: To support project staff in their assessment of impacts on historic places by managing and making available State Historic Preservation data for NPL sites in the Upper Clark basin.

Description: During forward planning and the RI/FS process project staff are required by law to perform a review process to determine the possible effect of their activities on properties that are eligible or are on the National Register of Historic Places (NRHP). The GIS staff has acquired and loaded historic preservation data from the Montana State Historic Preservation Office (SHPO). A preliminary easy-to-use menu driven query program using ARC Macro Language (AML) has been developed. The next step in the process is to acquire and convert into an ARC/INFO coverage *historic survey* data where it exists (e.g., for Butte) and to acquire and input *NRHP status* data for all SHPO sites. After the new data are loaded, the AML program will be updated and refined to accommodate these new data.

The SHPO AML query program is currently available at the State Library for use by the project staff. When the MDHES and the Montana EPA offices are linked into the GIS computer the project staff will be able to perform on-line interactive searches of the historic site and survey data.

To support the waste repository siting application described above, additional SHPO (historic sites, surveys, and NRHP status data) for a wider area of the Upper Clark Fork basin (to include the Blackfoot drainage) will be acquired and input to the GIS.

7.3.1.2 Data Acquisition

Based on the four applications outlined above and the existing data in the geographic information system, the following data have been identified for acquisition.

- State Historic Preservation Data: The GIS currently has State Historic Preservation data for Butte, Anaconda, and a buffer area along the Clark Fork River. These data include the location (to the PLSS quarter-section), SHPO identification code, and brief site description codes for 141 sites in Butte, Anaconda, and in a buffer along the Clark Fork. The GIS will acquire (from the Montana State Historic Preservation Office) *site, survey, and NRHP status* data to expand the coverage cover the entire Upper Clark Fork basin.

- Political Boundaries: County boundaries at a scale of 1:250,000 already exist on the system. City and other administrative boundaries would need to be digitized or converted from the US Census Bureau TIGER/line files.

- Transportation: Transportation data for the entire upper Clark Fork basin exists in the system from 1:100,000 DLG data. The scale of this data would not be appropriate for the large scale examination of land ownership. Transportation map coverages (center-lines of roads) are being created by the EPIC lab for the Butte Priority Soils Operable unit. This procedure could be used to produce higher resolution transportation data for the Anaconda area.

- Hydrography: As for the transportation data, 1:100,000 DLG hydrography data exist for the Upper Clark Fork basin. Higher resolution data would need to be obtained for the large scale examination of land ownership.

- Property Boundaries: These data would need to be digitized from county and city plat maps. Updates in land ownership changes will need to incorporated. These land ownership parcels will need to be tied to the land ownership information that is acquired from title searches and manually typed into the database.

- Unique Chemical/Materials Data: Sources of "unique" chemical/mineral mining material and the locations where this material has been found. The source for this data needs to be identified.

- US Public Land Survey System Data: PLSS data needs to be acquired for the entire upper Clark Fork basin. This data set would be used as a base theme in all of the applications outlined above and in many of the site specific applications. Currently the GIS has township corners for the entire basin, but these data need to be acquired to at least the quarter-section level. The USGS does not have PLSS data in DLG for any of the study area. Other state and federal agencies in Montana may have pieces of this data set in digital form and these can be acquired from them. For the areas where there are no digital data, the data will need to be digitized.

7.3.2 Anaconda

GIS applications for the Anaconda NPL site will serve the Community Soils operable unit and will support forward planning efforts and endangerment/public health assessments. These applications are described below.

7.3.2.1 Applications

1. Support Forward Planning

Operable Unit: Community Soils

Objective: To support forward planning effort by projecting contaminant distribution to direct sampling efforts to be conducted by PRP.

Description: The intent of this project is to perform overlay analysis of various base maps with the results of a vegetation classification process coupled with analysis of existing soils contamination data to establish and examine any correlations that would help direct future sampling. Additional data may be compared to these data in an effort to develop a better understanding of the existing conditions. This process will generate maps of identifiable stress by vegetation type in relation to iso-lines of soil-contamination (with confidence statements). This analysis is needed by January 1990.

Step 1: Create vegetation map coverage by classifying Thematic Mapper (TM) satellite data using ERDAS and ARC/INFO. This coverage should lead to the identification of areas where vegetation absence may equate to vegetation stress. If, through ground truthing of the image classification, vegetative stress is identifiable, the use of aircraft Multispectral Scanner (MSS) data to further this effort may be useful by providing larger scale data for those areas classified as having vegetation stress.

Step 2: Display the current knowledge of the nature and extent of the soil contamination around the smelter for each element of concern as maps. These maps would display the results of the vegetation classification effort, Urinary Arsenic data, soil survey data (Master Soils Investigation; CDC Soils Survey; CH2M Hill Soils Survey), and the "Bee Data." No attempt would be made at this stage to interpolate the various point data and perform statistical comparisons among the data sets. Instead a visual examination would be made of the sample locations with the associated values from one data set to those data in other sets. For example, the classified vegetation data may be displayed in relation to soil sample data. The resulting coverage may demonstrate, by visual examination, areas of vegetation stress and sample locations with high contaminant levels. This correlation would suggest two things: 1) it would support the vegetation classification, and 2) would suggest that this area may not need future sampling. Areas that indicate vegetation stress (from the TM and MSS data) and samples that indicate contamination may be identified. The surrounding areas may be then searched for areas that meet these same criteria.

Step 3: Develop maps displaying preliminary iso-lines for each contaminant horizontally and vertically (in the soil profile). These maps are a process of interpolating the soil sample data. To produce the soil contamination surface the various soil surveys must be normalized to provide the software with comparable contaminant-level values. The interpolation software to be used and the method for transfer of the results to the GIS still need to be identified. These maps would be used in conjunction with the overlays generated in the previous steps to assist in the design of further sampling. Based on proposed action levels for the site for individual contaminants or collections of multiple contaminants, use the GIS to assist in delineating areas where additional information should be collected before implementing very expensive remedies. It is expected that the boundaries between areas that fall above or below the action level would be thoroughly documented. This approach would focus future soil sampling efforts in areas where the greatest benefit could be derived and could potentially save considerable sums of money by avoiding grid approaches that would collect data in areas that were not critical with respect to action levels.

The process described above will help direct sampling efforts to be conducted by the PRP. After that sampling is completed, the results will be input to the GIS. The loading of this new data will assist in verifying the assumptions used in the above analyses as well as providing additional data that may be useful in oversight functions, forward planning on other operable units, and/or PRP and contractor RI/FS support.

2. Support of Endangerment Assessment/Public Health Assessment

Operable Unit: Community Soils

Objective: To assist the endangerment/public health assessments.

Description: This project would lead to the development of a risk map based on standard exposure assumptions and soil contaminant levels related to population distribution.

The GIS can be used to assign risk levels to contaminated areas by applying the risk calculations and associated assumptions to contaminated regions. The GIS could then be used to assign priorities for remedial activities in areas where the greatest risks/potential for exposure exist. To do this the GIS could compare various potential risk levels with areas where people are living at present based on land-use data.

This analysis could consider contaminant levels individually or collectively. In areas where multiple carcinogens occur, their effect would likely be additive. Similarly where several contaminants would have a toxic effect on the same organ in the body, these effects should be additive. The GIS would greatly facilitate these analyses and allow managers and scientists to refine assumptions as well as re-run the analysis in a time frame that would not be prohibitive. Much of the soil contamination data needed for this application will be acquired or generated by the application outlined above.

The GIS would continually be updated as new contaminant level and other data are received. Areas involved in remedial activity would continue to be refined, as the database improves, until the delineation of areas to be remediated falls within EPA's acceptable range of accuracy necessary to support a Record of Decision (ROD).

Discussion: One of the issues to resolve is: What, if any, are the required levels of certainty or levels of confidence for the soil contamination isohyets?

7.3.2.2 Data Acquisition

Isolines of Soil Contamination: This data set is required for Application 2--Support of Health Risk Assessment. This coverage will be generated and acquired through the Application 1--Support of Forward Planning.

Base Data (Hydro, Transportation, Railroads, Misc. Transportation,): This data exists on the GIS and was acquired from USGS 1:100,000 Digital Line Graph data.

Soil Survey Data (Master Soils Investigation; CDC Soils; CH2M Hill Soils): These data will be transferred from the Clark Fork Data Management System at the MDHES and generated into ARC/INFO map coverages. If no locational attributes are associated with these data, sample points will be digitized from source maps.

Urinary Arsenic: These data will be acquired from the Clark Fork Data Management System in the MDHES. A problem yet to be solved involves the location of the samples. Currently the samples are located only by street address. This locational information is not usable in the GIS. The street addresses will have to be converted to (x,y) point location data. When that conversion is completed by the DMS, these data will be transferred to the GIS.
Using overlay-analysis techniques, these data may be combined with the soils-contamination data in order to evaluate the relationships among these data sets. It is anticipated that 1.5 man-weeks will be required to process and check this data once obtained from the DMS.

Bee Data: These data are from a master's thesis study at the University of Montana. They are being transferred to the DMS. After the input and verification, these data will be transferred to the GIS and converted into ARC/INFO map coverages.

Topography: EMSL-LV is investigating the possibility of obtaining existing topographic data in digital form. This data may have been digitized by Horizon under a previous EPA contract. If it is not available, topographic data may be able to be acquired from the USGS in the form of four 7.5 minute Digital Elevation Models (DEM).

100-year Floodplain: ARCO is currently identifying the 100-year floodplain. This data will be digitized by ARCO and then supplied to the GIS.

Land-use and Vegetation: Land-use/land-cover data for the Anaconda study will be acquired through the use of 30-meter resolution satellite imagery. This effort may prove to be a more efficient method for acquiring generalized land-use data for the Anaconda study. Additionally, areas of lack of vegetation may be identified during the land-use mapping process. Once these stress areas are identified, they may be further studied using the more resolute aircraft multi-spectral scanner (MSS) data.

During acquisition of aerial photography for the study area, in August of 1987, MSS data, at 5-meter resolution, were accumulated at the same time. EMSL-LV staff have proposed to develop a hierarchical process in which areas of vegetative stress are initially flagged using the coarser satellite data, during the land-use mapping process. These flagged areas would then be investigated using the 5-meter MSS data to further refine the problem areas. The use of this hierarchical process would significantly reduce processing time of the highly resolute MSS data by using the satellite imagery for the initial screening of the data.

Following the photo analysis and subsequent digitizing effort, these data will be integrated with land-use data from the 1987 Clark Fork River Site Assessment study. This data has been acquired from CH2M Hill by EMSL-LV for use in Clark Fork Study. The CH2M Hill study includes information concerning land-use, demography, irrigated lands, tailings, wells, and other data that may be pertinent to the Clark Fork Superfund sites.

7.3.3 Silver Bow Creek

7.3.3.1 Applications

The Silver Bow Creek NPL site will use GIS techniques primarily to support data collection efforts and the identification of tailings types, extent, and volumes. These potential applications are described below.

1. Support Data Collection Efforts

Operable Unit: Area 1

Objective: To support field sampling efforts and perform data input to the Clark Fork Data System.

Description: CH2M Hill is preparing to conduct sample of the Colorado, Parrot, and Butte Reduction Works tailing to assist in the determination of the extent and depth of the buried tailing. The GIS Project and EMSL-LV will work with the contractor to help establish and identify sample locations using the Global Positioning System (GPS). This procedure will provide:

- more accurate sample location data at a lower cost than surveying;
- additional and more accurate control points for the GIS (this increased accuracy will help prepared better base maps for existing data and future data acquisition/analytical efforts); and,

- a small scale, pilot effort to help EMSL-LV and the GIS gain experience with the GPS. GPS is fast becoming an economic means of acquiring accurate locational information and has been proposed for use in other sampling efforts in the upper Clark Fork. This experience will help evaluate GPS accuracy and usefulness on the Clark Fork.

After the sampling is completed the resulting data will input to the GIS and maps created displaying the sampling results (e.g., sample locations, extent and depth of buried tailings). These data will also be used in the Streamside Tailings operable unit assessment of the distribution and extent of dispersed, impounded, and buried tailings along the Metro Storm Drain and Silver Bow Creek down to the Colorado Tailings.

An additional benefit of loading the sampling data into the GIS is the ability to help verify the accuracy of the sampling results and to help verify the accuracy of the land-use data being created for Butte by EMSL-LV and EPIC. The results of the CH2M Hill sampling will displayed in relation to existing base map data and land-use data for the study area. The resulting map will be examined for correlations among the various data. For example, the land-use data supplied by EPIC will be compared to the CH2M Hill data to see if their estimated areal extent for buried tailings has some correlation to surficial tailings in the land-use data.

Finally, maps displaying the sample locations, sampling techniques used (e.g., core borings and geo-reflectance), and results (e.g., extent and depth of buried tailings) will be produced for use by the project manager in data examination and verification, and for fact sheet and report publications.

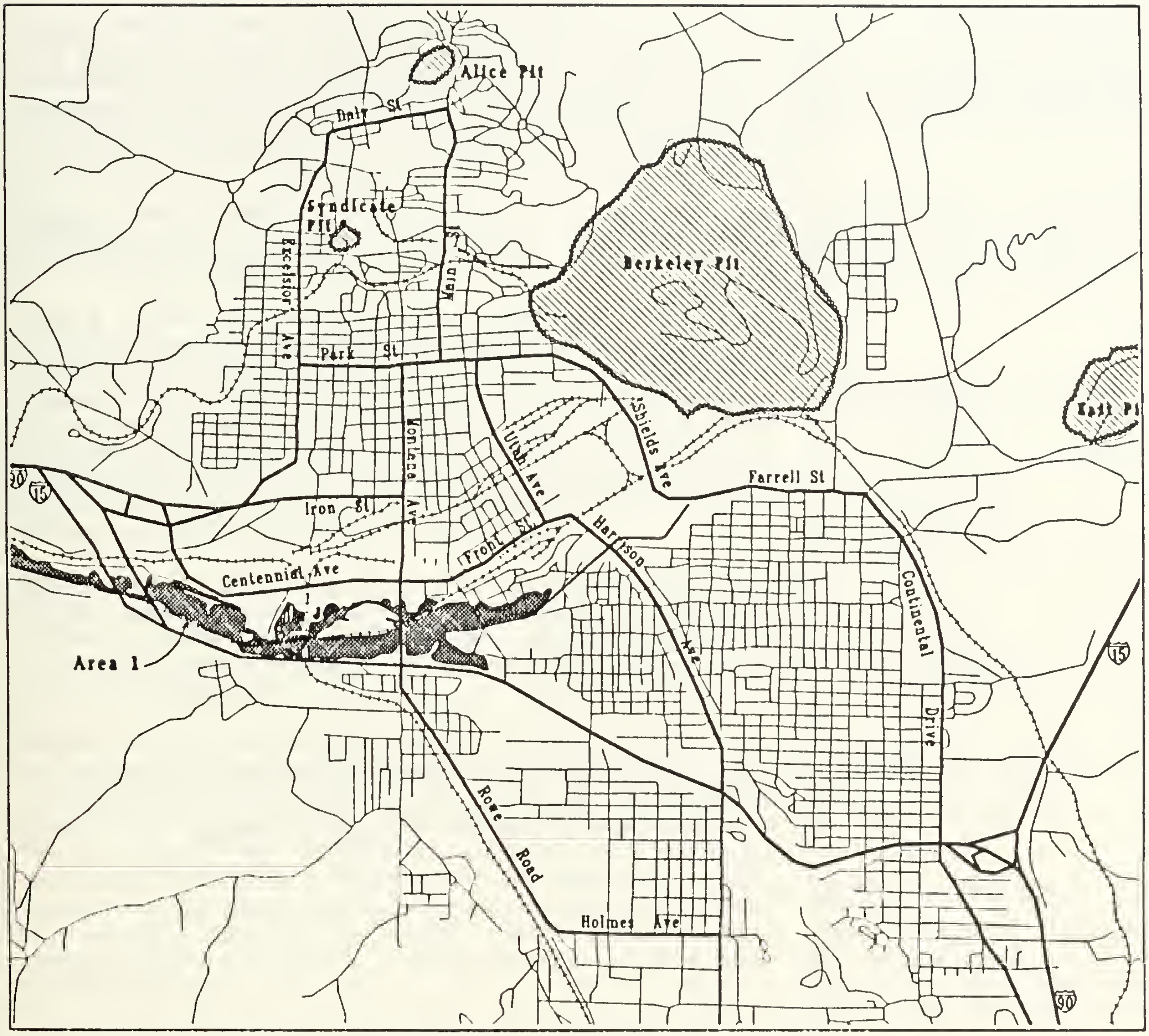

Figure 10 Map of Silver Bow Creek Area 1 operable unit boundary.

2. Determine Tailings Extent/Type

Operable Unit: Streamside Tailings

Objective: To determine the extent of dispersed tailings along the Metro Storm Drain and Silver Bow Creek down to Colorado Tailings.

Description: This project application is intended to define the extent and type of tailings along the Metro Storm Drain and Silver Bow Creek. Two products will be generated: 1) a map of current knowledge of the locations, extent, and type of tailings, and 2) a map of tailings (dispersed) based on the XRF Sampling and remote sensing techniques.

Step 1: Produce map of current knowledge using data from the previous application (extent and depth of Parrot, Colorado, and Butte Reduction Works buried tailings), floodplain, transportation, hydrography, and land-use (from EPIC interpretation) data. Besides providing a summary of the current knowledge of tailings extent and type, this map may be used to help locate the field samples. The maps of proposed field sampling locations may be used by contractors in the field to locate the actual sampling locations.

Step 2: (End of May) Field Sampling will be conducted using XRF sampling of dispersed tailings and core samples of buried tailings. These data will be transferred to the Clark Fork Data System for input to the geographic information system and the data management system.

Step 3: After the transfer of the data to the GIS, maps depicting the tailings boundaries (extent) will be produced by plotting the sample locations and values. Based on values determined by the project manager, an area will be delineated to represent the extent of the tailings. Where core samples are available estimates of the volume tailings will generated. These depictions of extent, volume, and preliminary assessment of type will help direct future sampling efforts to further refine horizontal boundaries of the tailings.

The process of characterizing existing knowledge to help direct future sampling which feed back into the process to further refine the knowledge of tailing extent could be repeated until a thorough characterization of the area is obtained. This process is diagramed in Figure 10.

Discussion: One issue to be resolved is: "How will sample sites be located?" Three options include: 1) ground survey with transit; 2) GPS System; and 3) grid based relational locations (eyeball). It is proposed that GPS be used. It is less expensive than transit surveys and more accurate than relational positional finding. In addition to locating field samples (both in determining where to place the samples and after the fact in re-locating sample sites), the GPS will aid in building good spatial control for all other data sets for this and other operable units.

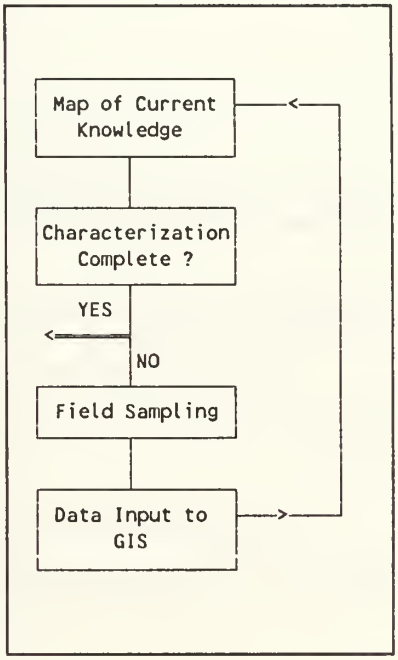

Figure 11 Model for Identification of Tailings Extent and Depth

3. Identification of Tailings Extent/Volume/Type

Operable Unit: Streamside Tailings

Objective: Assist in identification of tailings locations; calculation of tailings volumes; and classification of tailings types from Colorado Tailings to Warm Springs Ponds.

Description: Five different types of tailings--extending from the Colorado tailings to Warm Springs Ponds (27 miles)--have been identified from the STARS program sampling. The location and distribution of these five types have not been mapped except as identified at the discrete sample locations. Each type of tailings will require a different treatment. It is important to know the location and extent of each tailings type. XRF and soil samples will be conducted along the river.

This project will generate maps of:

1. Map of known data (sample locations with values, photo interpreted coverages of tailings)

2. Maps of tailings extent along floodplain by type
3. Maps of volumes

Step 1: The first step is to digitize study area boundary: 10, 25, 50, & 100 year floodplains. These data may be useful later for depth to groundwater calculations. EPIC and/or EMSL will interpret remotely sensed data to create coverages of land-use/land-cover. These data will then be transferred to the GIS. The GIS will create a coverage of the 36 STARS Study sample locations.

Step 2: Following the data input phase, the GIS will produce map of known data using:

- 100 year floodplain
- Interpreted tailings locations from the air photos data
- STARS Sample Locations
- Base data DLG (trans & hydro)

This map will identify areas will provide input to XRF sampling design.

Step 3: The field XRF field sampling will be conducted by contractors who will transfer the data to the Clark Fork Data System. The Global Positioning System should be used for generating the sample site locational data.

Step 4: The data from the field sampling effort will be input to the GIS. Maps will then be produced to display the raw data (sample locations and values). This procedure is helpful in data verification and provides a graphic preliminary display of the sampling results.

Step 5: Based on the XRF field data, the extent of the tailings can be refined and areas identified for the next round of soil sampling.

Step 6: Contractors collect soil samples to verify physical and chemical parameters.

Step 7: Transfer the data from the field sampling effort and produce maps of the raw data (sample locations and values) for data display and verification.

Step 8: Refine tailings extent from the new soil sample data.

Step 7: Classify tailings types based on the STARS classification. Using soil sample data, perform statistical analyses to class tailings into 5 types. Using the soil sample depth data, calculate depths/volumes for particular locations/tailings types. The identification of tailings types and locations may support the design and cost analysis of treatment alternatives.

7.3.3.2 Data Acquisition

Based on the applications described above the following data needs have been identified.

Core and Geo-reflectance Sampling Results: Load the results of CH2M Hill sampling task for Silver Bow/Area 1 efforts for the Colorado, Parrot, and Butte Reduction tailings. Locations will be determined with GPS.

10, 25, 50 & 100-year Floodplains: This task requires the use of CH2M Hill Flood Model maps. Program maps to identify the elevation of the 100-year floodplain. The FEMA maps have been acquired for all counties particular to the Clark Fork Project. These maps will be digitized following a significant amount of map preparation due to the varying scales of the source maps. It may be possible to digitize from the CH2M Hill maps.

Land-use: Land-use data for the Silver Bow study will be acquired by means of photo-interpretation of recent aerial photography. Photography currently available at EMSL-LV for the Silver Bow Creek area includes: 1986 1:8,000; and 1987 1:18,000. In the original *CFR Work Plan* (Version 1.3, 11/87), the interpreted data were to be transferred onto USGS base maps and digitized. This task has been allocated 2.0 man-weeks to complete, subject to map availability.

Currently, only 1954 versions of 1:62,500-scale USGS maps are available for Silver Bow, and the availability of 1:24,000-scale map products for this area is questionable. If the 1:62,500-scale base maps prove to be unsuitable for data compilation, it may be appropriate to have EPIC use their analytical stereo-plotter to digitally encode the interpreted data directly from the photography. This would require a change in the scope of work. Cost estimates are found in a later section and quality-assurance parameters are forth coming.

XRF and Other Soil Sample Data: XRF and other soil sample data for Area 1, Streamside Tailings, and Clark Fork operable units will be transferred to the Clark Fork Data System as machine readable data files. These data will collected, compiled, and transferred following specifications outlined in *Appendix F - Work Order Data Specifications*. The Global Positioning System should be used for the location and identification of sample sites.

Well Data: Well locations for along the Clark Fork (for the Clark Fork operable are loaded on the GIS. Attribute data (based on CFR screening study) for these wells needs to be supplied. The well data will be combined with the soils-contamination and land-use data using overlay-analysis techniques to provide insight into the relationships among these data.

Surface Water Quality: All surface and groundwater data (Multi Tek data) for the entire site should be in the DMS at MDHES. These data need to be verified and then transferred to the GIS.

Stream Erosion and Deposition: Streamside Tailings--Interpretation of aerial photographs will be used to detect areas of significant stream erosion, deposition, in conjunction with tailings identification. Low-altitude photos acquired from a mission flown in October 1986 will be used for this analysis. Photographic annotations will be transferred onto USGS base maps and digitized. Alternatively, the use of EPIC's stereo-analytical plotter may be integrated into this process. EPIC's role would increase labor requirements by approximately 1.5 man-weeks.

Silver Bow Creek Applications Outside 2-year Project Plan

The following potential applications would not occur within the time frame of this project plan. However they are briefly identified here because much of the data developed by GIS applications for the Butte and Silver Bow NPL sites would feed into these applications.

1. Butte Addition & Silver Bow

Objective: Help determine the relationship among ground water flow, mine and pit flooding in Butte, and non-point sources (urban run-off, etc.) to contamination.

Description: This is a common application between Silver Bow & Butte Addition operable units.

2. Tailings Identification

Operable Unit: Clark Fork River

Objective: Assist in identification of tailings locations and determination of tailings extent and volumes from Warm Springs Ponds to Milltown Reservoir.

Description: This application is similar to the one for Silver Bow Creek/Streamside Tailings. GIS products would include:

1. Map of known data (sample locations with values, photo interpreted coverages of tailings)

2. Maps of tailings extent along floodplain by type

3. Maps of volumes

Data acquisition for Clark Fork River Operable Unit:

Historic/Current Irrigation: Historic irrigation will be derived from the interpretation of archival aerial photography. This information will be transferred into a digital format through either digitizing of data transposed to base maps, or digitizing directly from annotated photography at EPIC. Additionally, the 1987 CH2M Hill study has information concerning historic irrigation within three time-frames; prior to 1955 and currently irrigated, after 1955 and currently irrigated, and historically irrigated but not currently irrigated. These data may augment the historic-photo analysis or negate it altogether. Additional time will be required to determine the usefulness of these source documents.

Surface Water Quality: Surface water-quality data are to be provided to EMSL-LV in digital format by the Region. It is anticipated that one man-week will be required to process and check this data.

As an indicator of surface-water quality, a macrophyte study may be considered for the Clark Fork River study. Low-altitude photography (August 1983 @1:8,000) available for this area may be interpreted for macrophytes by EMSL-LV photo-interpretation staff. This data would then be transferred to USGS base maps for digitizing or sent to EPIC for direct digitizing from photos. These activities would change the scope of work from the original work plan. Cost/time-frame estimates for a macrophyte study reveal an increase of approximately 5.0 man-weeks.

An additional component of the surface-water quality study may be the CH2M Hill 'Tailings and Wells' map series conducted for the Clark Fork River Site Assessment in 1987. These data are found on a series of 10 1:24,000-scale blue line maps for the Clark Fork River from it's headwaters near Anaconda to Milltown Reservoir near Missoula. These maps contain information relating to tailings, metal-enriched soils, and well locations. Results of the June-July 1987 well-sample survey should be obtained as part of this effort. It is estimated that 3.0 man-weeks would be required to assemble this data into it's final form.

Fisheries: Fish data from the State of Montana Department of Fish, Wildlife and Parks survey conducted in 1987 will be obtained and digitally encoded. Data collected include: biomass, mark and recapture, density, and diversity.

EPA River Reach data are currently available at EMSL-LV. River Reach mileage and milepost data will be compared with similar data from the Montana River Reach data set, and the 1:100,000-scale DLG Hydrography coverage to determine the relationships among them. If a consensus can be arrived at, survey and other data will be integrated with the chosen river-reach system.

Information contained in the CH2M Hill Clark Fork River Site Assessment study may be applicable to the fisheries investigation. In particular the Channel Gradient Profile, Sampling Locations & Geothermal Springs, and Tailings and Wells information may be useful. Input from site officers, fisheries biologists, and other resource personnel would be necessary to

understand the relationships among these data sets. If these data are to be used, tabular attributes associated with the sample sites and well locations will have to be obtained.

Results of the macrophyte study, using August 1983 @1:8,000 aerial photography, may have bearing on the fisheries quality and may be incorporated into this study.

Water Purveyor Districts: Water purveyor data are assumed to be available from local or state officials in the form of maps. These data can be digitized and assembled for the study area.

7.3.4 Butte Addition

7.3.4.1 Applications

The GIS will primarily support forward planning and sampling design for the Butte Addition of the Silver Bow Creek NPL site. In addition, GIS techniques will be used to attempt to model groundwater surface in relation to topography in an effort to identify potential areas of flooding for the Mine Flooding operable unit.

1. Support Forward Planning and Sampling Design

Operable Unit: Priority Soils

Objective: To support forward planning efforts by characterizing present condition and to assist the design of work plan sampling scheme.

Description: This application involves data input to support the characterization of the present condition and to support the future sampling designs. GIS products would include:

- Maps of the 39 Priority Soils Areas to be used by field personnel to establish their soil sample locations.

- Maps displaying of volumes of contaminated soils based upon:
    1) Depth
    2) Concentration

- Map displaying soil contamination in relation to population within the 39 Priority Soils Phase I areas

Step 1: The first step is to digitize the 39 Priority Soils Phase I areas. The digitizing will be done by an EPA contractor using the Clark Fork GIS facilities. The areas will be digitized from the 1:1,200 mylar maps of the Priority Soils areas created by CDM. Control for these maps will be provided by the EPIC lab using the air photos of the Butte area.

Step 2: Maps of the Priority Soils areas will be plotted for the field personnel to use to establish and mark the soil sample locations.

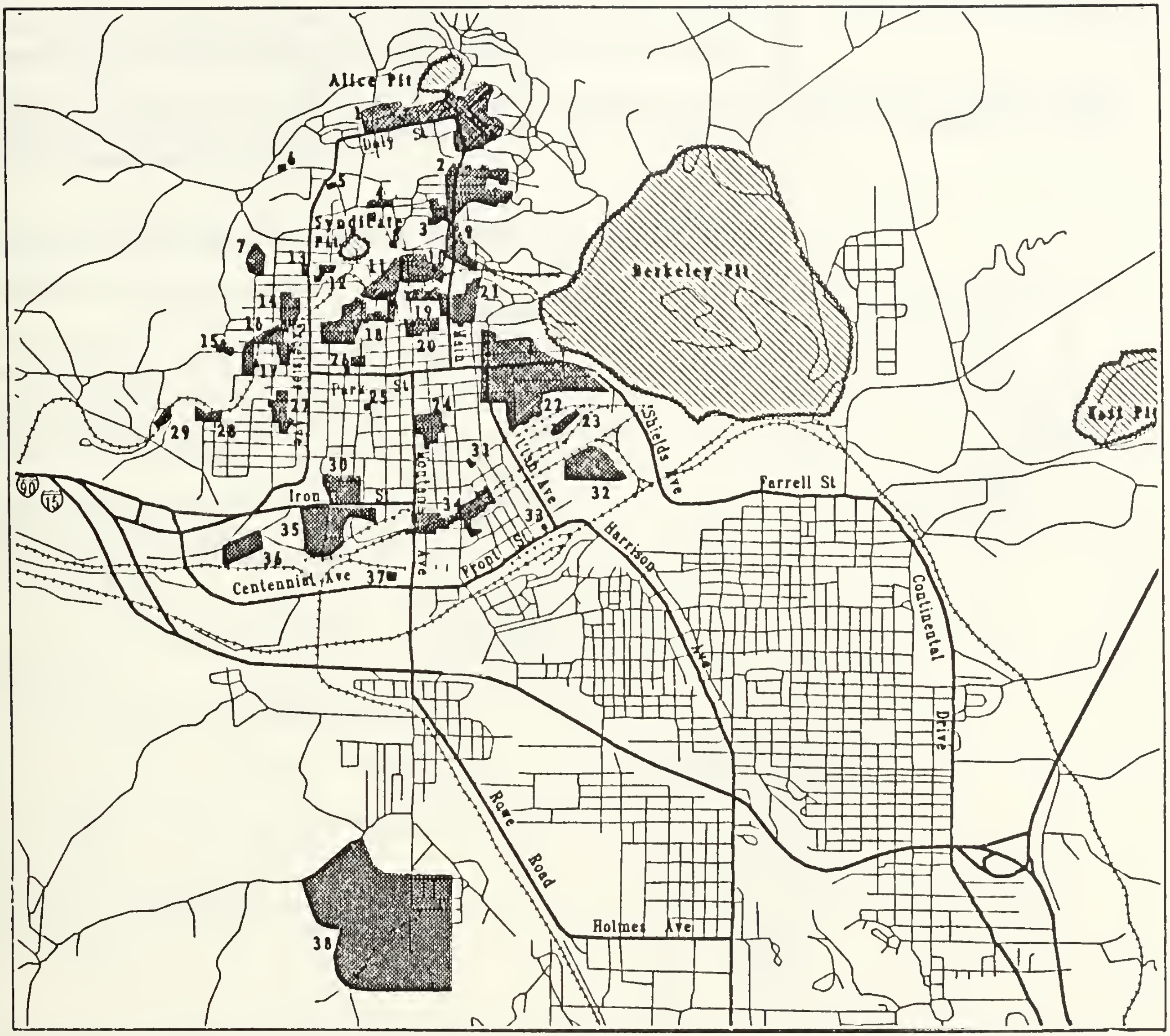

Figure 12 Map of Silver Bow Creek--Butte Addition Priority Soils Phase I Operable Unit.

Step 3: After the soils samples are conducted and the samples locations have been marked on the maps produced above, the soil sample locations will be digitized by the Clark Fork GIS and the lab data from the samples loaded into the system.

Step 4: Upgrade and register Butte data (census, etc.) to the better base map data from EPIC. Parcel ownership data for the 39 Priority Soils areas will be loaded on the GIS. A variety of maps may then be produced that display the results of the soil samples in relation to parcel ownership, and census data.

Base map data should be at a larger scale than 1:100,000, especially considering it's use with data generated at the 1" = 1000' scale, ala, the Butte land-use data from CDM. The BLOCKS data from the Radon Study or the data generated by the air-photo interpretation effort for

Butte land-use may be a more detailed source of base map data, which could be used to upgrade the existing Butte land-use data acquired from CDM.

Step 5: To calculate the volume of contaminated soils, a surface of contaminant depth would have to be generated. Sufficient data would be required to compare the contaminant depth to the topographic surface.

2. Support Endangerment Assessment/Public Health Assessment

Operable Unit: Priority Soils

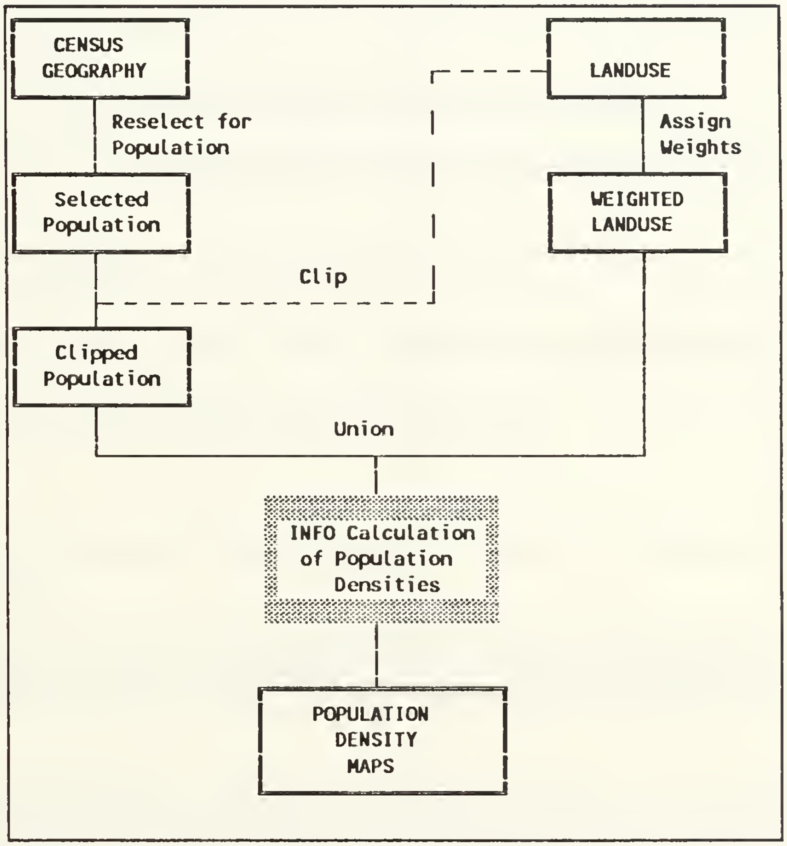

Figure 13 Model for population density mapping using weighted landuse data.

Objective: Support the determination of endangerment assessment/public health assessment for the Priority Soils Phase I operable unit.

Description: This application will generate various maps depicting the analyses of soil contamination in relation to:

1) Population density; age & sex specific
2) Land-use; residential neighborhoods, schools/play areas
3) Surface geology and faults/veins
4) Data from Montana Department of Health and Environmental Sciences report *Evaluation of Radon Sources and Phosphate Slag in Butte, Montana,* June 1983.

The first maps to be produced (May/June 1989) will display Butte population densities for the general population, children 0-5 years old, and children 6-13 years old. These maps will be based on 1988 projected populations. The population data to be used are based on 1980 census data obtained from Donnelley Marketing (via EMSL-LV). The population densities will be adjusted based on weighted values assigned to the various land-use categories. The basic procedure is depicted in Figure 11. These maps will support the Butte Priority Soils work order. Other maps to be included in the work order are: 1) a general reference map of Butte, 2) a color map of Butte land-use categories, 3) a reference map depicting the Priority Soils Phase I operable unit boundaries, and 4) a reference map depicting the Area 1 operable unit boundary.

3. Mine Flooding Modeling

Operable Unit: Mine Flooding

Objective: Model groundwater surface in relation to topography to identify potential flooding versus populated areas versus land-use.

Description: This project is intended to generate a map of potential flooding areas with indications of population and land-use.

For comparative purpose, the ideal groundwater surface would be generated from a data set as comprehensive as the topography. Obviously, this will not be available. The following may be tried:

- Develop a regularly-spaced sampling scheme based upon slope, and topography to obtain depth-to-groundwater data
- Use kriging software and TIN generate an 'depth-to-ground water' surface
- Use TIN to "subtract" the depth-to-groundwater surface from the topography surface to create a groundwater surface.

The relationship between depth-to-groundwater and potential for flooding must be substantiated for use in a modelling scenario.

Land-use data for Butte are being created by EPIC. This data will be compared to the groundwater surface coverage.

ARC/INFO coverages of mine tunnels with elevations needs to be created.

7.3.4.2 Data Acquisition

Census: Census geography has been digitized by EMSL-LV and has input to the GIS along with the associated demographic data.

Land-use: Land-use data for the Butte study will be acquired by means of photo-interpretation of recent aerial photography, August 1987. The Environmental Photographic Interpretation Center (EPIC) is using their analytical stereo plotter to digitally encode the interpreted data directly from the photography.

Soils Contamination/SOILS: The soils-screening survey data for 497 sample sites were acquired from CDM-Denver. This data has been processed into an INFO database. The data set contains toxic-contaminant levels for lead, arsenic, cadmium, and mercury. Sample data are available for three soil horizons; surface (0 - 1 inch), 1 - 12 inches, and 12 - 24 inches. An ARC/INFO coverage has been generated from this database, the attribute information has been associated with sample points, and the data have been input to the GIS.

The source map for the SOILS data was constructed by the Anaconda Mining Corporation (AMC) using a grid-reference system based upon an arbitrary origin. The units of measure for this reference are feet. The SOILS coverage units for these data are AMC feet. A program to transform the AMC map coordinates to UTM meters was developed by EMSL-LV and made available to the State.

Topographic Data: ARCO has taken on the responsibility of contracting for the production of large scale topographic mapping for the Butte area from EPA aerial photography. When this map compilation project is completed, the resulting digital data will transferred to the Clark Fork GIS.

A process is currently in use at EMSL-LV to generate topographic data using the ESRI's Triangulated Irregular Network (TIN) module. Elevation data are available in digital-elevation model (DEM) form from the USGS, based upon 1:24,000 quadrangles and may be processed using TIN to create topographic surfaces. A ancillary product of this process is a slope coverage. It is estimated that for the Butte area (four 7.5-minute quads) this process would take approximately 2.0 man-weeks. Conversations with NCIC personnel confirm that the DEM data are available from the USGS (Norton, 1988). Acquisition of one of the DEM's would require 4-5 weeks longer than the other three due to quality control requirements.

Historic Facilities: Historic mining and operations facilities will be produced from analysis of archival and current aerial photography. EMSL-LV has received archival aerial-photo indices for 1941, 1952, 1955, 1960, 1966, and 1980. 1976 photography is available through the USGS (Slonecker, 8/29/88). 1984 NHAP; 1983, 1986 and 1987 EPA photography is currently available in-house. These photographs will be visually interpreted and annotated for mining operation and facilities. These annotations will then be transferred to topographic map sheets and digitized. In addition to the historic facilities coverage, current mining facilities will be digitized from the 1" = 200' series of maps provided by CDM, Helena.

It is anticipated that this task will require 4 man-weeks photo-interpretation and 2 man-weeks of GIS work.

As in the case of the land-use data, only 1954 versions of 1:62,500-scale USGS maps are available for Butte. If the 1:62,500-scale base maps prove to be unsuitable for data compilation, it may be appropriate to have EPIC use their analytical stereo plotter to digitally encode the interpreted data directly from the photography. This would negate the recompilation of the data onto paper maps.

Butte Addition Applications Outside 2-Year Project Plan

1. Runoff Analyses

Operable Unit: Priority Soils

Objective: Evaluate effect of various alternatives in terms of surface configurations.

Description: Runoff analysis of various surface configurations which would result from the proposed alternatives.

Discussion: Being outside of the scope of this project plan, this application has not been developed in detail. However, three issues that will need to addressed are:

- Runoff co-efficients of the surface types and configurations would be required.
- Detailed slope analysis of the candidate sites would have to be produced.
- A run-off model would have to be created.

7.3.5 Milltown Reservoir

The GIS will provide cartographic support and database query support for the Milltown Reservoir NPL site as well as assisting an effort to model potential contaminant plume movement in groundwater.

7.3.5.1 Applications

1. Groundwater Plume Movement Modeling

Operable Unit: Downstream Screening

Objective: Direct future sampling efforts and evaluate alternatives for restricting contaminant movement in groundwater.

Description: Maps showing predicted groundwater contaminant plume movement, and displaying plume movement based on different modelling scenarios will be produced from this application.

Discussion: There are several issues to be resolved for this project. These include:

- The sources of the various data sets will have to be identified.

- The groundwater transport and fate model will have to be identified and made to accept digital inputs.

- The USGS in Montana has conducted a study of shallow aquifers in the Clark Fork that identified gaining and losing reaches of the river. This data would be helpful in understanding the interaction between the river and adjacent shallow aquifers.

7.3.5.2 Data Acquisition

Topography: This data should be able to be obtained from the USGS as 7.5 minute Digital Elevation Model data. It would be imported into ARC/INFO and a surface would be created using the TIN module.

Sub-Surface Geology: This data may be obtained from the U.S. Geological Survey.

Water Table Surface: The groundwater surface would be created by:

- Develop a regularly-spaced sampling scheme based upon slope, and topography and obtain depth-to-groundwater data in conjunction with data from existing well logs.

- Use kriging software and TIN generate an 'depth-to-ground water' surface

- Use TIN to "subtract" the depth-to-groundwater surface from the topography surface to create a groundwater surface.

Contaminant Levels: These data would be obtained from the MDHES and the Montana EPA.

7.3.6 Montana Pole Applications

While there are no specific GIS applications identified for the Montana Pole site, the project managers may make use of the graphic and other capabilities of the system for reports and presentations. There are data available for the Montana Pole site because of its location in Butte.

7.4 GIS APPLICATIONS AND ACQUISITION SUMMARY

Data required for the various applications described above will constantly be changing due to changes in the applications, schedule changes by the project managers, and state and EPA changes in priorities. The acquisition of data for the GIS will be evaluated by the Clark Fork Data System staff in consultation with state and federal project managers. The Data System staff will make recommendations to the Clark Fork Technical Working Group at each TWG meeting concerning revisions to the data applications and acquisition plan. A summary of the applications by site and operable unit with existing data and data to be acquired (as of April 1989) is displayed in Table I - Applications Summary. A summary of the data to be acquired, data sources, responsible agencies (who will collect and import the data), and other related information is contained in Table II - Data Acquisition Summary.

Table I Applications Summary

SITE/APPLICATION	Operable Unit	Existing Data	Data to Acquire	Products	Date Required
Basin-wide					
1. Base Map Data	Clark Fork-wide	100k TICS 24k TICS Transportation Hydrography Misc. Transportation Railroads County Boundaries Geographic Names PLSS Township Corners Historic Sites (partial) Rivers Study Data (partial) Heritage Data (partial)	Historic Surveys NRHP Status Data PLSS (to ¼ Sections) Rivers Study Data Heritage Data	Base Data to Support Applications Base Data for Cartographic Support Data Management Support	As Requested As Requested As Needed
2. Waste Repository Siting	Clark Fork-wide	Base Map Data (above) 1st Cut Locations	2nd Cut Locations Data as needed	ARCO & Contractor Support Siting Analyses Maps/Reports	As Requested As Requested As Requested
3. PRP Data Management	Clark Fork-wide	Base Map Data (above)	Political Boundaries Property Boundaries Ownership Data Operator Data Generator Data PLSS (to ¼ Sections) Land-use	Data Management Maps/Reports NBARS Analyses/Support	As Needed As Requested As Requested
4. SHPO Data Management	Clark Fork-wide	Base Map Data (above)	Historic Surveys NRHP Status Data	Data Management AML Query Program Maps/Reports	As Needed 10/89 As Requested
Anaconda					
1. Forward Planning Support	Community Soils	Base Map Data (above) Health Effects Soils Master Soils Phase II Soils Data	CDC Soils Data CH2M Hill Soils Data Bee Data Urinary Arsenic Topography Floodplains Land-use/Land-cover	Map/Coverage: Vegetative Stress Map/Coverage: Contamination Iso-lines Map: "Current Knowledge" Map: Areas to Sample Maps/Reports	10/89 10/89 11/89 12/89 As Requested
2. Endangerment Assessment	Community Soils	Base Map Data (above) Health Effects Soils Master Soils Phase II Soils Data	CDC Soils Data CH2M Hill Soils Data Bee Data Urinary Arsenic Topography	Map: Sample Data Map: Health Risk Map: Priority Areas for Remediation Maps/Reports	9/90 10/90 11/90 As Requested

SITE/APPLICATION	Operable Unit	Existing Data	Data to Acquire	Products	Date Required
			Floodplains Land-use/Land-cover Contamination Iso-lines Land-use/Land-cover		
Silver Bow Creek					
1. Data Collection Support (Parrot, Colorado, & Butte Reduction Works Tailings)	Area 1	Base Map Data (above) Census Geography/Data Schools/Play Areas Dumps Mill Sites Mine Shafts CDM Soils Samples Montana Pole Site	GPS Locational Data CH2M Hill Tailings Data (Geo-reflectance data) (core samples) Floodplains Surficial Geology Faults/Veins	GPS Support Map/Coverage: Sample Sites Map: Sample Results Data Verification Support Maps/Reports	Summer 1989 8/89 9/89 8/89-10/89 As Requested
2. Dispersed Tailings Identification (Metro Storm Drain to Tailings)	Streamside Tailings	Base Map Data (above) Census Geography/Data Schools/Play Areas Dumps Mill Sites Mine Shafts CDM Soils Samples Montana Pole Site	CH2M Hill Tailings Data XRF Data Soil Sample Data Land-use/Land-cover Floodplains	Map: "Current Knowledge" Map/Coverage: Sampling Sites Map/Coverage: Sampling Results Map: Tailings Extent Map: Tailings Type Maps/Reports	8/89 9/89 11/89 12/89 12/89 As Requested
3. Dispersed Tailings Identification (Colorado Tailings to Warm Springs Ponds)	Streamside Tailings	Base Map Data (above)	Land-use/Land-cover XRF Samples Soil Samples Floodplains	Map: "Current Knowledge" Map/Coverage: Sampling Sites Map/Coverage: Sampling Results Maps: Tailings Extent/Volume Maps: Tailings Type Maps/Reports	8/89 5/90 7/90 8/90 8/90 As Requested
Butte Addition					
1. Forward Planning Support	Priority Soils (Phase I)	Base Data (above) Census Geography/Data Schools/Play Areas Dumps Mill Sites Mine Shafts CDM Soils Samples Montana Pole Site Pit Boundaries Priority Soils Boundaries	Land-use/Land-cover Surficial Geology Faults/Veins Priority Soils Areas (1:1,200)	Map/Coverage: Priority Soils Areas Maps: Soil Contamination Maps: Contamination/Population Maps/Reports	9/89 9/89 9/89 As Requested
2. Endangerment	Priority Soils	Base Data (above) Schools/Play Areas Dumps Mill Sites Mine Shafts CDM Soils Samples Priority Soils Boundaries Pit Boundaries	Land-use/Land-cover Faults/Veins Priority Soils Areas (1:1,200) MDHES Radon Data	Maps: Contamination in Relation to: • Land-use • Surficial Geology & Faults/Veins • MDHES Radon Data Maps/Reports	Draft Final 8/89 4/91 8/89 4/91 8/89 4/91 As Requested

SITE/APPLICATION	Operable Unit	Existing Data	Data to Acquire	Products	Date Required
3. Mine Flooding Modeling	Mine Flooding	Base Data (above) Census Geography/Data Schools/Play Areas Dumps Mill Sites Mine Shafts CDM Soils Samples Montana Pole Site Pit Boundaries Priority Soils Boundaries	Land-use/Land-cover Surficial Geology Faults/Veins Priority Soils Areas (1:1,200) Groundwater Data Mine Tunnel Data Topography	Map/Coverage: Depth to Groundwater Map: Results of Run-off Model Maps/Reports	6/91 9/91 As Requested
Milltown Reservoir					
1. Groundwater Plume Modeling	????	Base Map Data (above)	Topography Groundwater Data Contaminant Data	Map/Coverage: Plume Movement Maps/Reports	7/91 As Requested
Montana Pole					
1. Graphics and Map Support	????	Base Map Data (above) Montana Pole Site Boundary		Maps/Reports	As Requested

TABLE II DATA ACQUISITION SUMMARY	Data Source	Input Method[2]				Responsible Agency[3]	Date Needed	Comments
		D	C	IA	M			
Basin-wide								
1. State Historic Preservation	SHP Office		X		X	MSL	10/89	NRHP Status & Survey Data
2. Political Boundaries	USGS Maps	X	X			MSL	11/89	Digitize by MSL
3. Transportation	Air Photos		X	X		EPIC/EMSL	2/90	May use USGS 7.5 DLGs to be available soon
4. Hydrography	Air Photos		X	X		EPIC/EMSL	2/90	
5. Property Ownership	Counties	X	X		X	Contractor	3/90	Sources yet to be identified
6. Unique Chemical/Materials	EPA	X			X	EMSL/MSL	3/90	Sources yet to be identified
7. Public Land Survey	USGS Maps	X	X			Contractor	3/90	May be acquired from P.I.
Anaconda								
1. Soil Survey Data	DMS		X			MSL	10/89	Import from DMS @ MDHES
2. Urinary Arsenic	DMS		X			MSL	10/89	Import from DMS @ MDHES
3. Bee Data	EPA/DMS		X			MSL	10/89	Import from DMS @ MDHES
4. Topography	USGS		X			EMSL/MSL	1/90	From USGS DEMs
5. Floodplain	FEMA	X				EMSL/MSL	2/90	May come from ARCO
6. Land-use/Land-cover	MSS/TM		X	X		EPIC/EMSL	2/90	Coordinated through EMSL-LV
Silver Bow Creek								
1. Land-use	MSS/TM		X	X		EPIC/EMSL	8/89	Requested for AREA 1 (6/89)
2. Floodplains	FEMA	X				EMSL/MSL	8/89	May be done by CH2M Hill
3. Area 1 Tailing Samples	CH2M Hill/DMS		X			MSL	9/89	Imported from CH2M Hill
4. Streamside Tailings Samples	CH2M Hill/DMS		X			MSL	9/89	Imported from CH2M Hill
5. Well Data	DMS		X			MSL	10/89	Imported from DMS @ MDHES
6. Surface Water Quality	CH2M Hill/DMS		X			EMSL	10/89	Procedure to be defined
7. Stream Erosion/Deposition	CH2M Hill		X			EMSL	11/89	Procedure to be defined
Butte Addition								
1. Land-use/Land-cover	MSS/TM		X	X		EPIC/EMSL	10/89	In progress (June 1989)
2. Topography	ARCO/EPA		X			EMSL/MSL	8/89	ARCO source
3. Historic Facilities	?					EMSL	9/89	Possibly from USGS map 1898
4. Radon Study	MDHES	X	X		X	DMS/MSL	9/89	To be added to DMS @ MDHES
5. Surficial Geology	MDHES	X	X			MSL	6/89	Will be finished in 6/89
6. Faults/Veins	MDHES	X	X			MSL	6/89	Will be finished in 6/89
7. Priority Soils/Ownership	CDM	X				CDM	9/89	Design in progress (6/89)
Milltown Reservoir								
1. Topography	USGS		X			EMSL/MSL	3/90	Use USGS DEMs
2. Groundwater Surface	USGS		X			EMSL/MSL	2/90	From USGS Well log data
3. Contaminant Levels	DMS/EPA		X			MSL	3/90	Import from MDHES/EPA

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[2] D = Digitize; C = Conversion/Import; IA = Image Analysis; M = Manual

[3] The entry for "Responsible Agency" (the agency responsible for data input) may change to a specific contractor as a project progresses.

CHAPTER 8 - BUDGET CONSIDERATIONS

This chapter presents the projected budget for the Data System for Federal Fiscal Years 1990 and 1991. Each major budget category is discussed, followed by the proposed budgets and summary tables. Also included in this chapter are discussions concerning accounting procedures and equipment disposition.

8.1 INTRODUCTION

The funding mechanism for the two components of the Data System mandates that the budgets for the two components be discussed separately. The Clark Fork Cooperative Agreement, which provides funding for both components of the Data System, is administered by MDHES; the Data Management component of the Data System is also administered by MDHES. The GIS component of the Data System is operated by the Montana State Library, which receives the necessary funding through an interagency agreement with MDHES. Therefore, sections 8.5.1 and 8.5.2, which summarize the entire Cooperative Agreement budget, include line items relating to general cooperative management along with the specific items necessary for administration of the Data Management System component. The entire GIS budget appears in the Cooperative Agreement budget summary as a single line item under the heading of Contracted Services. Thus, the grand total listed in the Cooperative Agreement budget summary represents the entire funding effort necessary to operate the Clark Fork Data System. Details of the GIS component are found in Sections 8.5.3 and 8.5.4.

In order to provide a mechanism by which the Data System would be maintained during the planning process which has resulted in the preparation of this project plan, funding for FY89 was provided at what was described in the FY89 cooperative agreement application as a "maintenance level". As a result of the planning process, applications have been described and Data System support activities have been identified which are necessary to respond to the needs of System users. In consideration of these applications and support activities, funding needs beyond that which can be considered "maintenance level" have been identified. The rational behind the funding needs identified is presented in a category by category discussion in Sections 8.2 and 8.3 below.

The budgets estimates presented reflect 100% of the costs for the operation and maintenance of the GIS. The portion of these costs charged to the Clark Fork Cooperative Agreement may be reduced as other users are brought on line, as reflected in the *Montana State Library Cost-sharing Plan, Addendum 1.*

The budgets presented below do not represent the total resource necessary to accomplish the data management and analysis goals of the System users. For example, costs of training in the use of the Data System provided to project personnel are expected to be arranged for by project personnel. Additionally, a significant portion of the site specific data acquisition costs are intended to be paid through individual site accounts.

8.2 OVERALL PROJECT MANAGEMENT AND DATA MANAGEMENT SYSTEM

8.2.1 Personnel

The Data Management System is currently minimally staffed to administer the System, accomplish limited data input, and provide limited "service bureau" access to the System.

A single staff person is assigned to the Data Management System. His duties include: management of the Clark Fork Cooperative Agreement, management of the contract with Montana State Library for GIS services, and management of contracts relating to system development and data acquisition; system maintenance; and coordination between the various

project personnel to insure their data management needs can be accomplished in an integrated fashion. System development and data acquisition have been accomplished through contracted services (See discussion under Section 8.2.6, Contracted Services). If the data management work load tends to level out in the future, it may be beneficial to convert funds from contracted services to support additional staff.

Also reflected in this section is funding support of mDHES personnel involved in management of the Clark Fork Cooperative Agreement. The FY90 budget reflects a state pay raise of 2.5%. The FY91 budget reflects the FY90 raise and an additional 2.5% raise in FY91.

8.2.2 Fringe Benefits

Fringe benefits are set at 22% for FY89. The projected rate for FY90 and FY91 is 22%; however, the rate is subject to change.

8.2.3 Travel

Provisions are made for travel for the purposes of meeting with EPA Region VIII management in Denver, Technical Working Group meetings held in Denver to accommodate EPA Region VIII involvement or in Las Vegas to accommodate EMSL-LV involvement, and training. Training is described under Section 8.2.8 Other.

8.2.4 Equipment

8.2.4.1 Hardware

In terms of hardware, the Data Management System is now configured to serve the identified needs of the site officers. Unless needs are identified in the future which require significant addition or modification of hardware, hardware acquisition will be limited to miscellaneous cables, cards and accessories.

8.2.4.2 Software

The major software necessary to serve the identified needs of the site officers has been acquired. It is expected that as applications develop, additional software needs will be identified. These might include geostatistics, modeling, and project tracking applications. Where possible, software costs will be kept to a minimum through running such applications in the PC environment; certain applications may require the speed and processing power of the mini-computer.

8.2.5 Supplies

The cost of miscellaneous office supplies necessary to serve the needs of the Data Management System is not expected to change other than due to inflation.

8.2.6 Contracted Services

Contracted services fall into one of three categories: user training and support; data system development and data acquisition; and GIS services.

8.2.6.1 User Training and Support

The Data Management System will be accessible to users within the MDHES through a department wide Local Area Network; however, under current staffing, there are provisions for only very limited user training and support for those desiring direct access. Training in

the use of the Environmental Information System software, the basis for the Data Management System, can be obtained through the developer, Environmental Systems Corporation. Provisions are made for one group training session to be provided on site in each of the two years covered by this plan.

8.2.6.2 System Development and Data Acquisition

Due to staffing limitations, significant modification of the system to respond to user needs and substantial data acquisition, entry or importation, and verification must for the most part be accomplished through contracted services. System development has been focused on implementation of a structure and supporting routines which will automate much of the future data importation; however, further development in this regard is necessary and it is unlikely that the process will soon be standardized to the point where significant manual restructuring, filtering, augmenting and coding is no longer necessary. That fact, coupled with the additional historical data to be integrated, requires that funding be provided for contracts with data entry personnel as well as specialists in automated data management. The sporadic nature of the work at this time favors contracted services as the method by which to obtain such services; however, the flow of data to the system may become controlled to the point where the hiring of additional staff may be an option to handle the duties previously contracted out.

8.2.6.3 GIS Services

GIS Services appears as a single line item under Contracted Services in the detailed budget breakdown for the Data System. GIS services are fully described under Section 8.3. Detailed budgets for the GIS are provided in Sections 8.5.3 and 8.5.4.

8.2.7 Construction

No construction will be undertaken as part of this project.

8.2.8 Other

Communications costs include a standard phone line, a line dedicated to telecommunications to allow for rapid data transfer to satellite data systems and other users, and a direct line to the GIS component to provide for direct access to the GIS through terminal emulation.

Provision is made for approximately three weeks of training each year.

8.3 GEOGRAPHIC INFORMATION SYSTEM

8.3.1 Personnel

The GIS budget proposals for FY90 and FY91 reflect a redistribution of staff resources as a result of project reorganization and the intent to make GIS services available to non Clark Fork Superfund users, as reflected in the *Montana State Library Cost-sharing Plan.* The NRIS Director's time devoted to GIS has been reduced from 40% to 5%. The GIS Officer is now referred to as the GIS Coordinator and his time has been reduced to 75% to more accurately reflect his evolving role as project manager of the Clark Fork Project and implementation of the *Cost-sharing Plan.* The GIS Programmer/Analyst will be still budgeted for 100% but will take on added GIS analyses responsibilities. This budget calls for the funding of a new position: GIS Data Technician. This position is required to perform the work tasks involved in implementing the *Data Administration Plan* (e.g., QA/QC, data dictionary maintenance) and the data input tasks described in the *Data Applications and Acquisition Plan.* The personnel budget projections also include an increase in the NRIS Data Technician's time for performing system back-ups and other computer and data tasks formerly performed by the GIS

Programmer/Analyst.

The FY91 budget shows the promotion of the GIS Programmer/Analyst I to a Programmer/Analyst II to reflect an increase in experience and responsibilities. The FY91 budget also calls for the creation of a Programmer/Analyst I position. This position will be needed as the GIS applications increase. The FY90 budget reflects a state pay raise of 2.5%. The FY91 budget reflects the FY90 2.5% raise and an anticipated 2.5% raise in FY91.

Each application described in Chapter 7 (including data acquisition and in relation to the implementation of the data administration plan) was examined for the staff resources that would be required. Ten overall types of tasks were identified. The definitions of the tasks are listed below and the summary results--by task--of the examination are listed for FY90 and FY91 on the following pages.

Definitions of task terms:

Data Input: map digitizing, data conversions

Data QA/QC: creating check plots, verifying both spatial and attribute data

Map Production: map composition and plotting

Data Administration: identification and entry of information into data dictionary, updating coverage documentation

Programming: designing, developing, and testing various computer programs (AMLs, FORTRAN, etc.) for data input, verification, analyses, and data output

Computer Operations: computer maintenance, user assistance

GIS Analysis: designing and implementing GIS applications

Training: attendance at GIS training classes and conferences

Project Administration: contract administration, meetings, project plan development, participation in the Technical Working Group, purchasing requisition preparation, accounting, etc.

Indirect Production: vacations, breaks, sick leave, library staff meetings, etc.

Staff Resources Requirements for FY 90

	NRIS Director	GIS Coordinator	GIS Programmer/ Analyst	GIS Data Technican	NRIS Data Technician	NRIS Administrative Assistant
Data Input	0	0	80	716	0	0
Data QA/QC	0	40	80	336	0	0
Map Production	0	404.8	1010	343.2	0	0
Data Adminstration	0	77	121	316	52	52
Programming	0	0	368	144	104	0
Computer Operations	0	52	260	52	416	0
GIS Analysis	0	412.8	536	0	0	0
Training	0	60	60	80	24	0
Project Administration	104	1070.4	88	20	10	468
Indirect Production	20.8	312	416	416	104	104
Projected	124.8	2429	3019	2423.2	710	624
Current Allocation	104	1560	2080	2080	520	520
Difference	-20.8	-869	-939	-343.2	-190	-104

Projected Hours: 9330

Projected FTE: 4.49

Allocated FTE: 3.3

Staff Resources Requirements for FY 91

	NRIS Director	GIS Coordinator	GIS Programmer/ Analyst II	GIS Programmer/ Analyst I	GIS Data Technican	NRIS Data Technician	NRIS Administrative Assistant
Data Input	0	0	40	40	750	40	0
Data QA/QC	0	40	80	80	330	20	0
Map Production	0	233.2	690	500	480	0	0
Data Adminstration	0	52	72	105	260	52	52
Programming	0	0	296	432	194	104	0
Computer Operations	0	52	104	260	104	416	0
GIS Analysis	0	355.2	595	519.2	0	0	0
Training	0	60	60	80	24	16	0
Project Administration	104	415	80	80	20	10	468
Indirect Production	20.8	312	416	416	416	104	104
Projected	124.8	1519.4	2433	2512.2	2578	762	624
Current Allocation	104	1560	2080	2080	2080	520	520
Difference	-20.8	40.6	-353	-432.2	-498	-242	-104

Projected Hours: 10553.4

Projected FTE: 5.07

Allocated FTE: 4.3

8.3.2 Fringe Benefits

Fringe benefits were set at 22% for FY89. The projected rate for FY90 and FY91 are 23% and 24% respectively; however, the rate is subject to change.

8.3.3 Travel

Provisions are made for out-of-state travel for the purposes of meeting with EPA Region VIII management in Denver, Technical Working Group meetings held in Denver to accommodate EPA Region VIII involvement or in Las Vegas to accommodate EMSL-LV involvement. Additional travel is budgeted for GIS training classes for new employees, new software, and specialized topics. This continual training effort is required for new staff as well as existing staff to maintain their expertise in a rapidly expanding field and to gain expertise to support user training. For a more detailed explanation of GIS training and user support see *Chapter 6 - User Support and Training* and Section 8.3.8 Other.

Money is budgeted for in-state travel to attend GIS and related meetings, conferences, and visits to the Superfund sites. These meetings include the Montana Technical Working Group which coordinates GIS activities and data sharing efforts among state and federal agencies within Montana. The GIS Coordinator at the MSL is a member of this committee.

8.3.4 Equipment

8.3.4.1 Hardware

In terms of hardware, the major hardware acquisitions are increased main memory (4mb for FY90 and 4mb for FY91) for the Prime, a modem, and two (one in FY90 and one in FY91) CLAC (communications ports) cards for the Prime. The incerase in main memory for the Prime is required to bring the system up to an effecticient operating level. The system has become "sluggish" due to the installation of a new Primos operating system (Revision 22.0) and a new version of ARC/INFO (Revision 5.0). As more Superfund users access the system, CPU execution time will continue to slow down thus mandating the increase in main memory. The modem and CLAC cards will allow greater access to the GIS by project personnel. The modem will allow a link to the EPA Region VII GIS in Denver, the EMSL-LV GIS, or other systems for data transfer and GIS processing. In addition the modem provides for the direct link of either MDHES or Montana EPA computers to the GIS. The major budgeted equipment acquisition for FY91 is a 770mb hard disk for the Prime.

Maintenance costs on equipment, which have been expensive, are expected to climb as equipment gets older and new product lines are introduced. Both the FY90 and FY91 budgets include "best guesses" for maintenance increases.

8.3.4.2 Software

The major software necessary to serve the identified needs of the site officers has been acquired.

The FY90 budget calls for the acquisition of the ARC/INFO NETWORK software module. This software will be used for modeling applications as outlined in *Chapter 7 - GIS Applications and Data Acquisition* (e.g., mine flooding). The NETWORK software is also used for address matching in the data input process of ownership information and will be used to assign street addresses for filed sampling maps.

Maintenance costs for software, which have been expensive, are expected to continue to climb. Both the FY90 and FY91 budgets include "best guesses" for maintenance increases.

8.3.5 Supplies

Supplies and materials include such items as magnetic tapes for system backups, plotter and printer supplies (paper, pens, ribbons, inks, etc.). This category shows an increase because of the addition of a new printer, increased work load (map plotting, more tapes for back-ups, etc.), and the addition of a computer supplies item that was previously under the equipment category.

8.3.6 Contracted Services

Montana State Library will not subcontract any of the work to be performed under its agreement with MDHES. However, under this category are included the system lease payments, maintenance payments for both hardware and software, rent and photocopy service to the State Library.

8.3.7 Construction

No construction will be undertaken as part of this project.

8.3.8 Other

The primary expenditure under this category is for training. Training for FY90 includes the Basic ARC/INFO course and Prime Computer course for the new GIS Data Technician position, an on-site class for ten staff people for the NETWORK software, and miscellaneous training. For FY91 training includes the Basic ARC/INFO course and a Prime computer class for the new GI S Programmer/Analyst I position, two specialized ARC/INFO courses (e.g., Geographic Analysis, Processing Techniques, AML Programming, etc.), and miscellaneous courses to be determined later.

Communications include the basic and long distance phone service.

8.4 DATA ACQUISITION COSTS

The acquisition of data is an expensive yet critical component of any GIS or Data System. The budgets for the GIS do not reflect specific costs for data acquisition. Much of this cost will need to be born by the specific sites and operable units. However, the GIS does have the equipment and, with the addition of the data technician position, the personnel to undertake some data input. This data input effort would include the transfer of data from EMSL-LV and other sources (e.g, USGS, BLM, contractors, etc.) and limited digitizing tasks. Extensive data input tasks (digitizing and/or manual data input) would need to be performed by others (e.g., digitizing contracts, EMSL-LV, temporary help for manual input, etc.). These data acquisition costs fall outside of this budgeting process since the State Library is not allowed to sub-contract work.

8.5 UPGRADE PATH PLANNING

8.5.1 Data Management System

As stated previously, the data management system is evolving. The existing system should be considered a prototype upon which to develop the concepts and structures which will guide future development. The Environmental Information System (EIS) was adopted because it provided a structure which will be portable, should the need arise to move the data into another system. There are many considerations which must be taken into account before committing to move to another system, including:

- Montana MDHES standards - Montana MDHES is in the process of implementing a department wide LAN for the purpose of improving communication and data sharing among bureaus. In order to insure the compatibility of data for the purpose of sharing among bureaus, development must take into account the diversity of data management systems in use.

- EPA Prime Network - EPA Region 8 is in the process of implementing a regional network consisting of Prime mini-computers at each state, tied to the regions Prime and to the NCC. Should the department elect to adopt this system, development and implementation of an alternative data management system may be necessary.

- ESRI developments - It is recognized that Henco, the developers of INFO, the relational data management software linked to ARC, has not kept pace with the leaders in the field of automated data management. Because INFO is not the data system of choice for many users, ESRI is in the process of improving the link between other systems (including Oracle) and ARC.

- ESC developments - Recognizing that Knowledgeman (the basis for the EIS) does not have all the features desired in a data management system, and recognizing that ESRI is moving toward a possible standard in relational data management systems, ESC is monitoring such developments, evaluating the desirability of moving the EIS into an alternate environment. Acquisition of the upgrade from ESC would considerably lessen the cost of development necessary to move the data management system into another environment.

8.5.2 Geographic Information System

Possible strategies for overall expansion of the GIS include:

- Build computing power of the Prime (upgrade to faster processor, increased RAM, increased disk capacity, more non-intelligent terminals).

- Build a more distributed network system (intelligent work stations, increased networking, ethernet, etc.).

- Acquire Oracle database software and ARC/INFO RDBI-O interface software. Once acquired, convert the EIS to Oracle and link the data in the EIS directly to the GIS without having to perform data conversions. This strategy effectively merges the two data systems into one.

The *User Survey* revealed that five site officers wished to be hands-on users of the system. However, four of these five respondents qualified their answer on the survey and in the follow-up interviews with such comments as: while they would like to become hands-on users they did not have the time to learn the system; they did not have the time to use the system; would need easy-to-use macros to help them; and would still need assistance from the GIS staff. These responses regarding system use greatly reduce the immediate need to purchase multiple graphics terminals or terminal emulation software but indicates a greater need for Clark Fork data system staff to work closely with the site officers in developing and implementing GIS applications. However, the project managers who expressed the desire to be on-line should eventually be linked to the system.

One way to develop links into the system is to place a work station (with internal disk) or a graphics terminal at EPA and at Montana MDHES to be available for database queries and processing requests. The DMS is being connected to the system through a dedicated data line, multiplexers, and T-Graf07 terminal emulation software. The EPA does not currently have a micro-computer capable of using the graphics terminal emulation software, but plans are for

them to acquire a new PC with EGA board. When that occurs, they can be connected to the system with a dedicated line to provide a link to the GIS/DMS.

Software Upgrades: The GIS upgraded to ARC/INFO 5.0 in June 1989. In addition the GIS has added the Triangulated Irregular Network software to the system in the Spring of 1989. These upgrades and additions provide new features and capabilities for the system.

Comments from the *User Survey* forms, as well as in the interviews, identified the desire to utilize special models or programs:

- Kriging or other interpolation programs to interpolate point data (e.g., for Anaconda forward planning and endangerment assessment); and,

- ground and surface water models (e.g, for Butte mine flooding).

Efforts will be made to identify applicable programs and procedures developed for gaining access to these programs (through contract, purchase, etc.).

8.6 CLARK FORK DATA SYSTEM BUDGETS

Based on the applications and data acquisition identified in the previous sections of this project plan, and the discussion in the Upgrade Path Planning and User Support and Training sections of Chapter 8, the following Clark Fork Data Management System and Geographic Information System budgets are proposed for FY90 and FY91. These budgets will be further refined for the final cooperative agreement application.

8.6.1 FY90 Clark Fork Cooperative Agreement Budget

Budget Period October 1, 1989 - September 30, 1990

The following summary includes details of the Data Management System budget, in addition to the overall project management costs. The GIS budget is represented by a single line item under Contracted Services. Details of the GIS budget for FY90 are found in Section 8.6.3.

I. Personnel

Title	Grade/ Step	FY89 Hourly Rate	Annual Hours	Annual Total	Category Totals
Env.Engineer Mgr. I	16/10	14.514	100	1451.40	
Comm. Relations Spec.	14/2	10.265	40	410.60	
Contracts Monitor/Audito	15/2	11.167	200	2233.40	
Accounting Technician I	9/6	7.680	100	768.00	
Document Clerk	11/12	10.661	80	852.88	
Attorney III	17/2	13.277	100	1327.70	
Legal Admin. Asst. IV	12/2	8.708	10	87.08	
Env. Programs Mgr.	17/12	16.774	30	503.22	
Bureau Chief	19/10	19.160	20	383.20	
Division Administrator	21/11	22.835	30	685.05	
Data Management Spec.	15/10	13.436	2080	27946.88	
Personnel Estimate - FY89 Rates				36649.41	
FY90 Salary Increase - @2.5%				916.24	
TOTAL PERSONNEL ESTIMATE					37565.65

II. Fringe Benefits

Calculated at	0.22 of Personnel	8264.44	
TOTAL FRINGE BENEFIT ESTIMATE			8264.44

III. Travel

	Annual
A. In State Estimate	500.00
In State Subtotal	500.00

B. Out of State Estimate

Estimate based on three trips for one individual for the purpose of attending training seminars plus two trips for one individual for the purpose of coordination and planning.

Single Trip Estimate (Training)

Airline tickets	500.00
Lodging ($60/Rm x 3 nights)	180.00
Per diem ($22.50/d x 4 days	90.00
Miscellaneous	50.00
Single Trip Subtotal	820.00

Total (3 trips)	2460.00	
Single Trip Estimate (Coordination)		
Airline tickets	400.00	
Lodging ($60/Rm x 2 nights)	120.00	
Per diem ($22.50/d x 3 days	67.50	
Miscellaneous	50.00	
Single Trip Subtotal	637.50	
Total (2 trips)	1275.00	
Out of State Subtotal	3735.00	
TOTAL TRAVEL ESTIMATE		4235.00

IV. Equipment

Item	Annual	
Cables/utilities/cards	2000.00	
Software	1000.00	
TOTAL EQUIPMENT ESTIMATE		3000.00

V. Materials and Supplies

	Monthly Estimate	Annual	
Miscellaneous office supplies	150	1800.00	
TOTAL MATERIALS & SUPPLIES ESTIMATE			1800.00

VI. Contracted Services

	Annual	
GIS (See budget summary - Table III)	248504.43	
Computer Consultant	15000.00	
Data Entry	8000.00	
User Training	2000.00	
Hardware Maintenance	1000.00	
Software Maintenance and Update	1200.00	
TOTAL CONTRACTED SERVICES		275704.43

VII. Construction	0.00	
TOTAL CONSTRUCTION ESTIMATE		0.00

VIII. Other

	Monthly Estimate	Annual
A. Communications	75	900.00

Telephone Equipment			
28 /month x 2 lines	56	672.00	
GIS comm. line rent	12	144.00	
B. Rent	100	1200.00	
C. Miscellaneous			
Training (3 conferences @ 600 fee/conf)		1800.00	
Other Miscellaneous	50	600.00	
TOTAL OTHER ESTIMATE			5316.00

H. Indirect

	Annual	
Calculated @ 0.171 x Personnel + Fringe Benefits	7836.94	
TOTAL INDIRECT ESTIMATE		7836.94

TOTAL DIRECT COSTS (less Contracted Services)	68018.03
CONTRACTED SERVICES	275704.43
GRAND TOTAL	343722.46

8.6.2 FY91 Data Management System Cooperative Agreement Budget

Budget Period October 1, 1990 - September 30, 1991

The following summary includes details of the Data Management System budget, in addition to the overall project management costs. The GIS budget is represented by a single line item under Contracted Services. Details of the GIS budget for FY91 are found in Section 8.6.4.

I. Personnel

Title	Grade/ Step	FY89 Hourly Rate	Annual Hours	Annual Total	Category Totals
Env.Engineer Mgr. I	16/10	14.514	100	1451.40	
Comm. Relations Spec.	14/2	10.265	40	410.60	
Contracts Monitor/Audito	15/2	11.167	200	2233.40	
Accounting Technician I	9/6	7.680	100	768.00	
Document Clerk	11/12	10.661	80	852.88	
Attorney III	17/2	13.277	100	1327.70	
Legal Admin. Asst.	12/2	8.708	10	87.08	
Env. Programs Mgr.	17/12	16.774	30	503.22	
Bureau Chief	19/10	19.160	20	383.20	
Division Administrator	21/11	22.835	30	685.05	
Data Management Spec.	15/10	13.436	2080	27946.88	
Personnel Estimate - FY89 Rates				36649.41	
FY90 & 91 Salary Increase - @5.0%				1832.47	
TOTAL PERSONNEL ESTIMATE					38481.88

II. Fringe Benefits

Calculated at	0.22 of Personnel	8466.01	
TOTAL FRINGE BENEFIT ESTIMATE			8466.01

III. Travel

	Annual
A. In State Estimate	500.00
In State Subtotal	500.00

B. Out of State Estimate

Estimate based on three trips for one individual for the purpose of attending training seminars plus two trips for one individual for the purpose of coordination and planning.

Single Trip Estimate (Training)

Airline tickets	500.00
Lodging ($60/Rm x 3 nights)	180.00
Per diem ($22.50/d x 4 days	90.00
Miscellaneous	50.00
Single Trip Subtotal	820.00

Total (3 trips)	2460.00	
Single Trip Estimate (Coordination)		
Airline tickets	400.00	
Lodging ($60/Rm x 2 nights)	120.00	
Per diem ($22.50/d x 3 days	67.50	
Miscellaneous	50.00	
Single Trip Subtotal	637.50	
Total (2 trips)	1275.00	
Out of State Subtotal	3735.00	
TOTAL TRAVEL ESTIMATE		4235.00

IV. Equipment

Item	Annual	
Cables/utilities/cards	1000.00	
Software	500.00	
TOTAL EQUIPMENT ESTIMATE		1500.00

V. Materials and Supplies

	Monthly Estimate	Annual	
Miscellaneous office supplies	150	1800.00	
TOTAL MATERIALS & SUPPLIES ESTIMATE			1800.00

VI. Contracted Services

	Annual	
GIS (See budget summary - Table III)	290439.29	
Computer Consultant	10000.00	
Data Entry	8000.00	
User Training	2000.00	
Hardware Maintenance	1000.00	
Software Maintenance and Update	1200.00	
TOTAL CONTRACTED SERVICES		312639.29

VII. Construction	0.00	
TOTAL CONSTRUCTION ESTIMATE		0.00

VIII. Other

	Monthly Estimate	Annual
A. Communications	75	900.00

Telephone Equipment			
28 /month x 2 lines	56	672.00	
GIS comm. line rent	12	144.00	
B. Rent	100	1200.00	
C. Miscellaneous			
Training (3 conferences @ 600/conf)		1800.00	
Other Miscellaneous	50	600.00	
TOTAL OTHER ESTIMATE			5316.00

H. Indirect

	Annual	
Calculated @ 0.171 x Personnel + Fringe Benefits	8028.09	
TOTAL INDIRECT ESTIMATE		8028.09

TOTAL DIRECT COSTS (less Contracted Services)	67826.98
CONTRACTED SERVICES	312639.29
GRAND TOTAL	380466.27

8.6.3 FY90 Geographic Information System Budget

Budget Period October 1, 1989 - September 30, 1990

I. Personnel

Title	Grade /Step	Hourly Rate	Hours	Salary Cost		Category Totals
NRIS Director	16/6	13.239	104	1376.86		
GIS Coordinator	15/2	11.167	1560	17420.52		
GIS Programmer/Analyst	13/2	9.399	2080	19549.92		
GIS Data Technician	11/2	8.079	2080	16804.32		
NRIS Data Technician	11/2	8.079	520	4201.08		
NRIS Admin. Assist.	11/2	8.079	520	4201.08		
						$63,553.78
					2.5% State Pay Raise	$1,588.84
Total personnel						$65,142.62

II. Fringe Benefits

Calculated at .23% of Personnel		$14,982.80

III. Travel

In State	1000.00	
Out of State	6000.00	
Total Travel		$7,000.00

IV. Equipment	Qua.	Unit Cost	Total	
Misc. Furniture & Accessories			1000.00	
Modem--Prime	1	3000.00	3000.00	
4mb Main Memory Increase--Prime	1	8000.00	8000.00	
PC Software Programs			500.00	
Software Module (ESRI-NETWORK)	1	11000.00	11000.00	
CLAC Communications Card (4 lines each)	2	500.00	1000.00	
Total Equipment				$24,500.00

V. Materials & Supplies

Miscellaneous	12	200.00	2400.00	
GIS (Plotter paper, pens, tapes, etc.)	12	350.00	4200.00	
Resource Document Updates	3	350.00	1050.00	
Computer Supplies	12	400.00	4800.00	
Total Materials				$12,450.00

VI. Contracted Services

System Lease (monthly rate) (Includes hardware & software)	12	5150.00	61800.00
Maintenance			
Hardware (Prime)	12	1300.00	15600.00
ERDAS SSS	12	350.00	4200.00

FORTRAN 77	12	85.00	1020.00	
ARC/INFO	12	800.00	9600.00	
ARC/INFO Source Code	12	125.00	1500.00	
CalComp (Digitizer & Plotter)	12	300.00	3600.00	
Tektronix Terminals (2 @ 100/month)	12	200.00	2400.00	
TIN	12	100.00	1200.00	
Hard Disk	12	125.00	1500.00	
Tektronix 4696	12	30.00	360.00	
Text Editor	12	65.00	780.00	
Misc.	12	150.00	1800.00	
Photocopies	12	25.00	300.00	
Rent (700 sq. ft./month)	12	186.08	2233.00	
Total Contracted Services				$107,893.00
VII. Construction				
Total Estimated Construction			0.00	$0.00
VIII. Other				
Basic Service (Mainframe)	12	150.00	1800.00	
Telephone Service				
Basic Service (4 lines)	12	48.00	576.00	
Use - $16.50 per hour @ 20 hours per month	12	330.00	3960.00	
Postage	12	50.00	600.00	
Training Course Fees				
PRIME Courses	1	1000.00	1000.00	
ARC/INFO Basic Course	1	3000.00	3000.00	
ARC/INFO Course	1	600.00	600.00	
NETWORK (2-day on-site training)	1	3000.00	3000.00	
Miscellaneous Training Fees		2000.00	2000.00	
				$16,536.00
Grand Total				$248,504.43

8.6.4 FY91 Geographic Information System Budget

Budget Period October 1, 1990 - September 30, 1991

I. Personnel

Title	Grade /Step	Hourly Rate	Hours	Salary Cost		Category Totals
NRIS Director	16/6	13.239	104	1376.86		
GIS Coordinator	15/2	11.167	1560	17420.52		
GIS Programmer/Analyst II	14/2	10.265	2080	21351.20		
GIS Programmer/Analyst	13/2	9.399	2080	19549.92		
GIS Data Technician	11/2	8.079	2080	16804.32		
NRIS Data Technician	11/2	8.079	520	4201.08		
NRIS Admin. Assist.	11/2	8.079	520	4201.08		
						$84,904.98
					5% State Pay Raise (FY90 & FY91)	$4,245.25
Total personnel						$89,150.23

II. Fringe Benefits

	Category Totals
Calculated at .24% of Personnel	$21,396.06

III. Travel

		Category Totals
In State	1000.00	
Out of State	6000.00	
Total Travel		$7,000.00

IV. Equipment	Qua.	Unit Cost	Total	Category Totals
770mb Disk with Controller	1	20000.00	20000.00	
4mb Main Memory Increase--Prime	1	8000.00	8000.00	
Misc. Furniture & Accessories			1000.00	
PC Software Programs			500.00	
CLAC Communications Card (4 lines each)	2	500.00	1000.00	
Total Equipment				$30,500.00

V. Materials & Supplies

	Qua.	Unit Cost	Total	Category Totals
Miscellaneous	12	225.00	2700.00	
GIS (Plotter paper, pens, tapes, etc.)	12	350.00	4200.00	
Resource Document Updates	3	350.00	1050.00	
Computer Supplies	12	400.00	4800.00	
Total Materials				$12,750.00

VI. Contracted Services

	Qua.	Unit Cost	Total
System Lease (monthly rate) (Includes hardware & software)	12	5150.00	61800.00
Maintenance			
Hardware (Prime)	12	1430.00	17160.00
ERDAS SSS	12	385.00	4620.00
FORTRAN 77	12	95.00	1140.00

ARC/INFO	12	1000.00	12000.00	
ARC/INFO Source Code	12	125.00	1500.00	
CalComp (Digitizer & Plotter)	12	330.00	3960.00	
Tektronix Terminals (2 @ 100/month)	12	220.00	2640.00	
TIN	12	110.00	1320.00	
NETWORK	12	110.00	1320.00	
Hard Disk	12	137.50	1650.00	
Tektronix 4696	12	35.00	420.00	
Text Editor	12	75.00	900.00	
Misc.	12	150.00	1800.00	
Photocopies	12	25.00	300.00	
Rent (700 sq. ft./month)	12	186.08	2233.00	
Total Contracted Services				$114,763.00

VII. Construction

Total Estimated Construction	0.00	$0.00

VIII. Other

Basic Service (Mainframe)	12	150.00	1800.00	
Telephone Service				
Basic Service (5 lines)	12	60.00	720.00	
Use - $16.50 per hour @ 20 hours per month	12	330.00	3960.00	
Postage	12	50.00	600.00	
Training Course Fees				
PRIME Courses	1	1000.00	1000.00	
ARC/INFO Basic Course	1	3000.00	3000.00	
ARC/INFO Courses	3	600.00	1800.00	
Miscellaneous Training Fees		2000.00	2000.00	
				$14,880.00

Grand Total	$290,439.29

8.6.5 Budget Summaries

Summaries for the FY90 and FY91 Budgets for both the data management system and the geographic systems are shown in Table I[1]. This summary depicts the anticipated expenditures for the Data System broken down by the DMS and the GIS.

Table I Clark Fork Data System FY 90 and FY 91 Budget Summary

Data System Budget Summary FY 90 & 91	DMS FY 90	GIS FY 90	DMS FY 91	GIS FY 91
I. Personnel	37,565.65	65,142.62	38,481.88	89,150.23
II. Fringe Benefits	8,264.44	14,982.80	8,466.01	21,396.06
III. Travel	4,235.00	7,000.00	4,235.00	7,000.00
IV. Equipment	3,000.00	24,500.00	1,500.00	30,500.00
V. Materials and Supplies	1,800.00	12,450.00	1,800.00	12,750.00
VI. Contracted Services	27,200.00 (less GIS)	107,893.00	22,200.00 (less GIS)	114,763.00
VII. Construction	0.00	0.00	0.00	0.00
VIII. Other	5,316.00	16,536.00	5,316.00	14,880.00
Indirect Costs	7836.94	0.00	8,028.09	0.00
Totals	$95,218.03	$248,504.43	$90,026.98	$290,439.29

8.7 ACCOUNTING

In order to insure proper accounting of costs, the State Library/NRIS shall establish separate responsibility centers on the State Budget and Accounting System (SBAS) for each Superfund site and Operable Unit as required and for general Superfund services not related to a specific site. Costs to each center shall be actual costs or shall be established by statistical records of resource and time allocation. The method adopted to assign costs shall be approved by DHES.

The NRIS has acquired and installed a cost-accounting program (Log-Time by Computronics) for the Prime mini-computer. This program records Connect, CPU, and I/O times. Connect time is the actual time the user was connected to the computer. CPU time is the amount of

---

[1] The GIS component of the Data System is operated by MSL as a contracted service under the Clark Fork Cooperative Agreement. Included in the Clark Fork Cooperative Agreement budget summary as a line item under the Contracted Services category for both FY90 and FY91 are the total budget estimates for the Geographic Information System. For the purpose of displaying the actual funding level for each component, the GIS costs have been subtracted from the overall project management and DMS totals presented in Table I above.

processing time used during the period the user was connected to the computer. I/O time is the amount of input/output or disk read/write time used during the time the user was connected to the computer. Using the cost-accounting program and the Prime operating system language, percent of storage space used in the disks can also be recorded.

8.8 EQUIPMENT DISPOSITION

To support the development of the DMS and the GIS various items of computer hardware and software have been acquired with federal funds. Final disposition of these items must be in accordance with applicable federal procurement practices, as defined in 40 CFR, Part 35.

It is expected that the DMS and the GIS will continue as a critical supporting tool during at least the next several years of Superfund activities in the Clark Fork River Basin. Present plans envision the systems being used on other Superfund and environmental or natural resource programs in subsequent years. Work on non-Superfund activities will be charged to the appropriate user. Since it is anticipated that these users will be primarily other federal and state entities, it may be appropriate for the computer equipment to remain with the State.

An additional factor to consider is the rapid obsolescence of computer equipment. It may be that the depreciation rate renders the equipment valueless within the time-frame of the project for which they were originally purchased. In any case, sufficient records must be maintained so it would be possible to establish a fair market value should the equipment need to be disposed of (no longer be used) for whatever reason. The State will be required to notify EPA whenever this equipment is no longer needed. EPA will then provide specific disposition instructions.

ADDENDUM A

MONTANA STATE LIBRARY GIS COST-SHARING PLAN

This Cost-sharing Plan is designed to establish a process by which non-Superfund users may attain access to and use the Clark Fork Superfund Geographic Information System (GIS). The Cost-sharing Plan outlines preliminary policies to govern non-Superfund GIS use and to effect a long-term transition of the GIS from its current status as an exclusive Superfund resource to a cost-shared, statewide resource.

A. HISTORICAL PERSPECTIVE OF THE CLARK FORK SUPERFUND GIS

The U.S. Environmental Protection Agency (EPA), Region 8-Montana Office determined in early 1987 that a GIS would be a valuable tool in achieving the goals of the Upper Clark Fork River project. In June, 1987, EPA officials met with Montana Department of Health and Environmental Services (DHES) and other state personnel to develop a plan to provide GIS capability. Subsequently, EPA and DHES officials selected the Montana Natural Resource Information System (NRIS), housed at the Montana State Library (MSL), to develop a GIS that would specifically and exclusively serve the Clark Fork Superfund project. At the same time, all parties agreed that at some point down the road, the GIS should and could be used to serve other purposes in Montana under a cost-sharing agreement.

Through a cooperative agreement between the EPA and the DHES, and subsequently, an interagency agreement between the DHES and the MSL, signed in September, 1987, NRIS was granted authority to initiate GIS development. The interagency agreement provided the assurances for the State Library to enter into a five-year lease with the Environmental Systems Reserach Institute, Inc. (ESRI) to supply hardware and software for the project. The computer equipment was procured to meet specific technical and fiscal requirements outlined for the Superfund project; DHES and EPA suggested and preferred the lease to facilitate the implementation of the cost-sharing strategy when and if it became appropriate.

As stiptulated in agreements, the GIS computer equipment would be used exclusively for the Clark Fork Superfund project until such time as that project was fully and effectively supported. It was understood that this period of exclusive use would be a minimum of two years and could be as many as five years before other, non-Superfund users would have access (if any) to the GIS. It was also understood that throughout this period of exclusive use on behalf of the Superfund project, the EPA and the DHES would support all operational, maintenance, and capital costs of the system. This operational plan was considered by all parties to be in the best interests of the Superfund project, particularly given the complexities of the project and the GIS applications.

As of June, 1989, with the completion of the "Clark Fork Superfund Data System Master Project Plan," GIS needs and specific applications are better understood and system requirements to meet those needs are more fully defined. Based on this "Master Plan," project site officers and data system personnel anticipate that during the period of the next cooperative agreement (i.e., October, 1989 to September, 1991), the need for exclusive use may not be absolute. Hence, a transition to the resource/cost-sharing operational plan should be initiated.

B. SHARED-USE OBJECTIVES AND POLICIES

During the next two years, the opportunity may arise for some capacity of the Superfund-GIS resource to become available for non-Superfund use. It should be noted that the system requirements planned for this period to serve Superfund work (as outlined in the Cooperative Agreement application) are conservative estimates, so the possibility does exist that no capacity will be available to market. On the other hand, the timing of planned applications may work

out so that there is available computing power (C.P.U. time) without slowing down any Superfund work; or there may be input/output devices available (terminals, printers, plotters, etc.) at off-peak times or between Superfund work.

When opportunities arise, NRIS proposes to engage in contracts to utilize the available GIS capacity. In accordance with policies and procedures set forth below, any non-Superfund users of the GIS would pay a fair and equitable cost for such use. The revenue generated and collected by NRIS would be used to support system operational costs. It is expected that these revenues will offset and reduce the GIS costs to the Superfund project, as budgeted in the 1990-91 Cooperative Agreement application and "Master Project Plan," referenced above. These shared-use policies also establish a framework to implement the long-term transition of the GIS from its current status as an exclusive Superfund resource to a cost-shared, statewide resource.

1) Satisfy the GIS needs of all staff working on the Clark Fork Superfund sites, including federal, state and contractor personnel, as specified in the 1990-1991 Cooperative Agreement and the "Clark Fork Superfund Data System Master Project Plan;"

   a. Meet Clark Fork Superfund GIS project needs in the most efficient and cost-effective manner possible; and

   b. Administer the Clark Fork GIS project within the stringent requirements, both fiscal and programmatic, of the Superfund program, including careful documentation of all costs;

2) Identify and engage non-Clark Fork Superfund users of the GIS in a resource-sharing and cost-sharing strategy, under the following conditions:

   a. primary access and absolute priority of Clark Fork Superfund GIS users must be maintained;

   b. only those Superfund-GIS resources that are not or will not be in use can be made available to non-Superfund users;

   c. any non-Superfund users must pay rates that are equitable to the Superfund project use;

   d. all staff time allocated, expendable materials purchased (e.g., computer tapes, plotter paper, etc.), and special charges incurred (e.g., cost for specific phone lines for computer communications, special computer programs or models, mailings, etc.) to support or complete non-Superfund work will be paid fully by the respective contracted user;

   e. computer time will be billed based on time used; printing and plotting rates will be calculated based on time and materials used; all computer-related charges will be recorded by the internal cost-accounting system installed in January, 1989;

3) Revise these policies in response to their effectiveness in recovering costs and meeting the long-term, cost-sharing strategy; policy revisions build in the needed flexibility to respond to changes in costs, operations and use profiles. This approach protects the priority of Superfund users while expediting the opportunity for non-Superfund users to get on the system.

CLARK FORK SUPERFUND DATA SYSTEM

MASTER PROJECT PLAN

APPENDICES

DRAFT

June 23, 1989

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Appendix A: CLARK FORK COOPERATIVE AGREEMENT - FY89

CLARK FORK
COOPERATIVE AGREEMENT

REVISION

PREPARED BY:

SOLID & HAZARDOUS WASTE BUREAU
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
HELENA, MONTANA

FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
HELENA, MONTANA

AUGUST 1988

CLARK FORK COOPERATIVE AGREEMENT

Project Description

The Clark Fork Cooperative Agreement provides funding for development and implementation of a consolidated data management system and geographic information system (GIS), a project which constitutes a component of EPA's plan to manage the Clark Fork Superfund Sites as a region. The current agreement was initiated on March 31, 1987, and runs through September 30, 1989.

Reference is made to the Clark Fork Cooperative Agreement application dated March 26, 1987 for a complete project description. The agreement as originally adopted encompassed the following activities:

A. Coordination and technical support for issues and activities among all Clark Fork basin Superfund sites and other state projects.

Coordination is provided through the Clark Fork Project within the Montana Governor's Office. Specific tasks associated with this activity include:

- Review and comment on RI/FS documents to assure integration of state environmental requirements in CERCLA work.
- Review and comment on work plans, scoping and screening studies to assure compatibility with existing and planned state agency activities.
- Participate in review and development of a consistent and approved EPA-State policy on work with PRP's.
- Participate in identification of operable units and establishing priorities for addressing these sites.

B. Development and implementation of a coordinated common data base for all CERCLA sites in the Clark Fork River basin.

Specific tasks initially associated with this component include:

- Develop information management specifications and recommendations.
- Install a prototype environmental information system.
- Implement data entry from the various Clark Fork sources.

C. Development of a computerized Geographic Information System (GIS) for all major CERCLA site data.

Specific tasks and products initially associated with this component include:

- A planning document which will identify key questions pertaining to the Superfund effort which the GIS system can be used to answer.
- An inventory of existing data sets and remote sensing information.

- A determination of additional data needs to satisfy the RI/FS process.
- A map of the floodplain with accompanying historical analysis showing likely deposition sites.
- Digital files of topography, land cover, census, geology and well data (approximately 7 USGS 1:100,000 quadrangle maps) installed on the state's GIS system with trained staff available in Helena to process the information as needed for Superfund work.

The project description remains accurate with the following exception:

- It was initially intended that the data system be established and maintained in the Office of the Governor; however, due to constraints on handling the funding through that office and due to space limitations, the data base has been implemented through the Department of Health and Environmental Sciences (DHES). This modification was approved as a minor modification to the cooperative agreement.

First year objectives have been accomplished. A summary of first year activities is presented under Project Status. Second year objectives are outlined under Proposed Activities.

Project Status

The project status has been routinely reported in the form of quarterly reports and is briefly summarized below:

Data System

- A data system manager has been hired. In addition to further development and management of the data base, this individual is also responsible for coordination with the GIS project to ensure system compatibility.
- The Clark Fork Cooperative Agreement has been modified to more accurately reflect project requirements and to reflect the move from the Office of the Governor described above.
- Equipment needs have been identified; equipment has been installed and configured for the data system.
- Consultant services for initial program development and data loading have been obtained through the competitive negotiation process.
- The system software has been installed and tested; software modifications necessary to meet the needs of the project have been identified and system modification is underway.
- Loading of historical data has begun. Data associated with the Anaconda Site and the Silver Bow Creek Site have been entered.
- Data system compatibility specifications have been developed. The specifications describe various levels of compatibility which can be achieved by agencies and organizations having the need to share data with the data system.
- Data coding forms and instructions are being developed. The instructions describe data reporting methods and standards necessary to insure the ability to incorporate all data collected

by various independent contractors into the data system.
- RPMs and State Project Officers have been provided with language to include in future task orders to insure compliance with the compatibility specifications and data coding instructions.

Geographic Information System Component

- An interagency agreement has been entered into with Montana State Library which provides for housing and operation of the GIS project at the library.
- A GIS officer and a GIS technician have been hired.
- The initial equipment and software needed have been identified, installed and tested.
- Training in the operation of the GIS is underway. Training was initially provided to twelve individuals including EPA, DHES, and MSL staff directly connected with the Clark Fork Superfund sites. Additional in-depth training is being provided to the GIS Officer and GIS Technician.
- The digitization of the initial data set is underway at Environmental Monitoring Systems Laboratory, Las Vegas. Products are loaded, evaluated for completeness and accuracy, and added to the data base as they are made available.
- A GIS task force has been formed and has met to provide direction relative to data acquisition, pilot projects, and long term planning.
    - To assist the task force, a needs survey has been conducted to identify necessary products as well as to determine the appropriate level of involvement of the various EPA RPMs and State Project Officers. The results of the needs survey will become the basis for a formal project plan (see Proposed Activities).
- A GIS Resource Document has been prepared. The document contains general information relevant to GIS, as well as information specific to the Clark Fork GIS, including:
    - data base status and projections
    - system capabilities
    - access and use information
    - GIS educational resource material
- An initial inventory of existing data sets and remote sensing information pertinent to the Clark Fork system sites has been prepared.
- The system is operational and is responding to user requests for special purpose mapping. Initial work is being performed on a pilot project selected by the GIS task force which involves the Anaconda Smelter Site (See Attachment "C", Anaconda Smelter Site GIS Project Planning Document).

Clark Fork Project Coordinator Activities

- Involvement in the development of memorandum of understanding with Anaconda Minerals Company.
- Organization of Clark Fork Task Force meetings.
- ARAR's development.
- Data System and GIS planning.

- Water Quality Standards Considerations.
- Community Relations.
- Clark Fork Fish Kills.
- Selection of Data System Manager and GIS Officer.
- Operable unit/master plan subgroup meetings.
- Mill Creek Consent Decree meetings.
- Interaction with Federal Emergency Management Agency.
- Reclamation demonstration project initiation.

GIS Component Evaluation and Recommendations

The Clark Fork Cooperative Agreement funds a continuing project with an initial project period running from March 31, 1987 through September 30, 1989. Funding was provided for the first year of operation. Before releasing funding for the remainder of the initial project period, a determination was made that an in depth, third party review of the GIS component was necessary to assess the utility of that component in terms of satisfying the expressed needs. On July 27, 1988, at the request of the Director, EPA Region VIII Hazardous Waste Management Division (HWM), an on-site evaluation of the GIS component was conducted by the Office of Program Management and Technology. A copy of the report of that evaluation and a letter from the Director, HWM, expressing support of the findings in the report is included as Attachment "A". DHES response to the recommendations, expressed in a letter from the Administrator, Environmental Sciences Division, DHES, to the Director, HWM, is included as Attachment "B". Compliance with the recommendations made is accomplished through the work plan described under Proposed Activities.

PRP Involvement

Meetings have been held with representatives of ARCO, a PRP at all of the Superfund Sites associated with the project, to explain the function of the project, to describe proposed products and potential uses of the data system and GIS, to discuss options for consideration of ARCO's needs when developing applications and to discuss the possibility of sharing data, giving appropriate consideration to data security and integrity. ARCO officials have expressed support for the concept, and have indicated a desire to utilize data in the system and products generated from the system for purposes consistent with the project goals. Formalization of ARCO's involvement is addressed under Proposed Activities.

Proposed Activities

Proposed project management activities include:

- Implement the recommendations made by the Office of Program Planning and Technology and endorsed by Region VIII, including:
    - Appointment of representatives of the Department of Health and Environmental Sciences and Montana State Library to serve on a management level Steering Committee.
    - Expansion of the existing GIS task force to form a Technical Working Group (TWG) with representation from:
        - Montana Department of Health & Environmental Sciences
        - Montana State Library

    - Office of the Governor
    - EPA Region VIII
        - Montana Office
        - Environmental Services Division
        - Hazardous Waste Management Division
        - Information Management
    - Environmental Monitoring Systems Laboratory - LV

    - The first meeting of the TWG will be held on or about September 15, 1988 for the purpose of evaluating the needs assessment (see Project Status) and beginning development of a project plan. Thereafter, the TWG will teleconference as necessary and meet quarterly to carry out operational aspects of the GIS, including appropriate scheduling and application specific justification for acquisition of hardware, training, service, networking, and other support requirements. The TWG will provide an accounting of its activities to the Steering Committee in the form of meeting minutes and appropriate documents.
- Development by May 1, 1989, of a draft comprehensive project plan which will become the basis for extension of the cooperative agreement for the period October 1, 1989 through September 30, 1991.
- Acquisition and implementation by December 1, 1988 of an accounting software system to insure that fiscal objectives for appropriate use of Superfund resources can be met.
- Development and implementation by March 1, 1989 of a data administration program which will insure that appropriate QA/QC is performed in a cost effective manner.
- Development of protocols which will provide a mechanism for PRPs, local government, and other agencies or organizations associated with the Clark Fork Superfund Sites to benefit from the system, while protecting the integrity of the data.
- Coordination with Region VIII Environmental Services Division (ESD) for support services related to application design, data administration, and system integration.
- Coordination with Environmental Monitoring Systems Laboratory in Las Vegas (EMSL-LV) to expedite the production of initial data layers and products.
- Work with agencies or organizations collecting data pertinent to the Clark Fork Superfund Sites to develop data management plans consistent with the goals of the data system.

Proposed data system activities include:

- Complete the development of data coding forms and instructions: Provide forms and instructions to contractors involved in data collection efforts to insure that data collected from this point forward will be recorded in a compatible format to allow for incorporation into the data system in a timely manner.
- Develop a mechanism for importing data from and exporting data to

contractors' data management systems which provides for the integrity of the data and eliminates the need for manual entry of data into two systems.

- Complete the identification and loading of data relating to the Clark Fork Superfund Sites collected prior to the implementation of the consolidated data system.
- Load new data relating to the Clark Fork Superfund Sites as it is made available.
- Locate additional data relating to the Clark Fork Superfund Sites not collected as a Superfund effort but which may be of use to project personnel; identify mechanisms for access to that data.
- Train project personnel in the fundamental use of the data system to increase access to the data.
- Respond to user requests; the data system is available now to serve user needs in terms of data storage, retrieval and analysis.

Proposed GIS activities include:

- Complete facility organization and hardware and software installation, configuration and testing by October 31, 1988.
- Continue training in the use and operation of the Prime computer, and ARC/INFO, ERDAS and PRIMOS software.
- Install digital data files produced by EMSL as they are made available.
- Maintain and update quarterly an inventory of existing data sets and remote sensing information pertinent to the project.
- Maintain and update quarterly a resource document describing current and planned data in the GIS, procedures for using the GIS, and descriptions of data input and analysis procedures.
- Develop a plan for initiation of a pilot project (see Attachment "C"), to be presented to the TWG for consideration .
- Perform site specific data input and analysis related to projects selected by the TWG.

Proposed coordination activities include:

- Integrate the concerns relating to the Clark Fork Superfund Sites into an interagency report summarizing existing environmental conditions in the Clark Fork River Basin and make recommendations for agency actions.
- Provide support to Clark Fork Basin Superfund site managers through review of and comment on RI/FS documents.
- Coordinate CERCLA and non-CERCLA activities in the basin, assist in the identification of operable units, and establish priorities.
- Assist data system manager and GIS officer in obtaining essential information to implement the data system and GIS.

Coordination activities are to be carried out using funds obligated under the original cooperative agreement. No additional funding for coordination activities is requested in this revised application.

Estimated Budget

The project plan and budget presented support a "maintenance level" project for the period October 1, 1988 through September 30, 1989, which provides a means to implement the recommendations made by the Office of Program Planning and Technology. Major equipment acquisition recommended by the Office of Program Planning and Technology is not fully supported by the proposal. Full development of the system will be addressed in the project plan developed by the TWG, and will be incorporated in future revisions of the cooperative agreement. The proposal:

- provides funding to keep the system operational through the planning and set-up phase.
- identifies the recommendations made by the Office of Program Planning and Technology as deliverables to be accomplished within a reasonable time.
- provides adequate time and resources to do a thorough job on the project plan.
- delays acquisition of major equipment until after completion of the project plan.
- provides the ability to begin equipment and personnel testing through the execution of a pilot project under the direction of the TWG.

Estimated budget figures are presented in the following tables:

Table I	Estimated total project budget per object class category
Table II	Estimated second year project budget breakdown
Table III	Estimated second year GIS component budget breakdown

Explanations of budget line items, where appropriate, immediately follow Table III.

TABLE I

CLARK FORK COOPERATIVE AGREEMENT

Object Category Summary - Total Project
Budget Period March 31, 1987 - September 30, 1989

Category	Current	2nd Year Addition	TOTAL
Personnel	36605	37948	74553
Fringe Benefits	7465	8348	15813
Travel	5132	6205	11337
Equipment	19783	1600	21383
Supplies	2470	3000	5470
Contractual *	270143	214963	485106
Construction	0	0	0
Other	3236	3567	6803
TOTAL DIRECT	344834	275631	620465
Indirect	5166	5880	11046
GRAND TOTAL	350000	281511	631511

* Portion of Contracted Services dedicated to GIS

TABLE II

CLARK FORK COOPERATIVE AGREEMENT

Management/Support/Data System
Budget Period October 1. 1988 - September 30, 1989

A. Personnel

Title	Grade/ Step	Hourly Rate	Annual Hours	Annual Total
Env.Engineer III	15/10	13.317	100	1331.70
Comm. Relations Spec.	14/2	10.266	160	1642.56
Contracts Monitor/Auditor	15/2	11.167	200	2233.40
Accounting Technician	9/6	7.622	100	762.20
Document Clerk	11/13	10.661	80	852.88
Attorney III	17/2	13.277	100	1327.70
Legal Admin. Asst.	11/6	8.800	50	440.00
Env. Programs Mgr. I	16/12	15.396	30	461.88
Bureau Chief	18/10	17.558	15	263.37
Division Administrator	21/11	22.835	30	685.05
Data Base Manager	15/10	13.436	2080	27946.88

TOTAL PERSONNEL ESTIMATE 37948

****

B. Fringe Benefits

Calculated at 0.22 of Personnel 8348

TOTAL FRINGE BENEFIT ESTIMATE 8348

****

C. Travel

	Annual
In State Estimate	1000
In State Subtotal	1000

^^^^^^^^^

Out of State Estimate

Estimate based on three trips for one individual for the purpose of attending training seminars plus - three trips for one individual for the purpose of coordination and planning.

Single Trip Estimate (Training)

Airline tickets	400
Lodging ($60/Rm x 3 nights)	180

Per diem ($22.50/d x 4 days)		90
Miscellaneous		50
Single Trip Subtotal		720
Total (3 trips)		2160
Conference Registration ($500/cf x 3)		1500
Training Subtotal	3660	
	^^^^^^^^	
Single Trip Estimate (Coordination)		
Airline tickets		300
Lodging ($60/Rm x 2 nights)		120
Per diem ($22.50/d x 2 days)		45
Miscellaneous		50
Single Trip Subtotal		515
Total (3 trips)		1545
Coordination Subtotal	1545	
	^^^^^^^^	
TOTAL TRAVEL ESTIMATE	6205	
	********	

D. Equipment

Item	Annual
Cables/utilities/cards	1000
Repair & maintenance of computer equipment	600
TOTAL EQUIPMENT ESTIMATE	1600
	********

E. Materials and Supplies

	Monthly Estimate	Annual
Miscellaneous office supplies	250	3000
TOTAL MATERIALS & SUPPLIES ESTIMATE		3000
		********

F. Contracted Services

	Annual
GIS (See budget summary - Table III)	214963

TOTAL CONTRACTED SERVICES	214963
	********

G. Other

	Monthly Estimate	Annual
Rent	100	1200
Telephone Equipment		
28 /month x 2 lines	56	672
Communications	75	900
GIS comm. line		
Installation		75
Rent	10	120
Miscellaneous	50	600
TOTAL OTHER ESTIMATE		3567
		********

H. Indirect

	Annual
Calculated @ 0.127 x Personnel + Fringe Benefits	5880
TOTAL INDIRECT ESTIMATE	5880
	********

TOTAL DIRECT COSTS (less contractual)	66548
CONTRACTED SERVICES	214963
GRAND TOTAL	281511
	********
	********

TABLE III

CLARK FORK COOPERATIVE AGREEMENT

Geographic Information System Component
Budget Period October 1, 1988 - September 30, 1989

A. Personnel

Title	Grade /Step	Hourly Rate	Hours	Salary Cost	Benefits @ 0.22	Salary + Benefits	Category Totals
NRIS Director	16/6	13.239	832	11014.85	2423.27	13438.12	
GIS Director	15/2	11.167	2080	23227.36	5110.02	28337.38	
GIS Research Assistant II	11/2	8.079	2080	16804.32	3696.95	20501.27	
Library Technician	9/3	7.144	520	3714.88	817.27	4532.15	
Accountant	14/8	11.846	230	2724.58	599.41	3323.99	
Total Personnel							$70,132.91

B. Materials & Supplies	Qua.	Unit Cost	Total	
Office Supplies	12	175.00	2100.00	
GIS Supplies	12	375.00	4500.00	
Photocopies	12	25.00	300.00	
Resource Document Updates	4	300.00	1200.00	
Total Materials				$8,100.00

C. Computer Services & Equipment	Qua.	Unit Cost	Total
Electrical Line Conditioner	3	1500.00	4500.00
Off-site back-up tape storage			
72 tapes @ .45/tape/month = 32.40	12	32.40	388.80
Box Storage at ISD	12	14.80	177.60
PC Software Programs			650.00
T-Graf 07 Emmulation Software	1	1000.00	1000.00
Cost Accounting Program for Prime	1	600.00	600.00
Text Editor for Prime	1	3500.00	3500.00
496mb Hard Disk for Prime	1	15000.00	15000.00
Modem for PC	1	500.00	500.00
CLAC Communications Card (4 lines each)	1	375.00	375.00
Misc. Computer Equipment			
(cables, switch boxes, etc.)			1000.00
TRAINING:			
PRIME Courses:			
1. Intro to Computing on a PRIME	1	1100.00	1100.00
ESRI Courses:			
1. ARC/INFO System Programming	1	1000.00	1000.00
2. Cartographic Production	1	500.00	500.00
3. Geographic Analysis	1	500.00	500.00
ERDAS Training	1	500.00	500.00
Miscellaneous Courses			1000.00
MSL Rent (400 sq. ft./month)	12	99.00	1188.00
System Lease (monthly rate)			
(Includes hardware & software)	12	5150.00	61800.00
Maintenance (monthly after warranties expire)			
Hardware (Prime)	12	1067.00	12804.00
ERDAS SSS	12	166.67	2000.00
FORTRAN 77	12	72.00	864.00
ARC/INFO	3	600.00	1800.00
CalComp (Digitizer & Plotter)	12	253.00	3036.00

Tektronix Terminals (2 @ 75/month)		12	150.00	1800.00	
Hard Disk 2 @ 92.00/month each		12	184.00	2208.00	
Total Computer Services					$119,791.40
D. Office Equipment		Qua.	Unit Cost	Total	
Computer Workstation Desk for ERDAS		1	600.00	600.00	
Light Table		1	500.00	500.00	
Total Office Equipment					$1,100.00
E. Travel					
In State				735.00	
Out of State (EMSL, Training Courses, etc.)				8767.50	
Total Travel					$9,502.50
F. Communications		Qua.	Unit Cost	Total	
a. Basic Service (Mainframe)		12	150.00	1800.00	
b. Telephone Service					
Basic Service (4 lines)	48.00	12		576.00	
Use - $16.50 per hour @ 20 hours per month	330.00	12		3960.00	
Total Communications					$6,336.00
Grand Total					$214,962.81

TABLE III-A

CLARK FORK COOPERATIVE AGREEMENT

GIS Component Travel Budget
Budget Period October 1, 1988 - September 30, 1989

Out-of-state

Trip Description	# of Days	Food	Lodging	Transportation	Misc.	Trip Total	
Denver TWG ABC	2	45.00	120.00	350.00	50.00	565.00	
Denver Steering Comm. JCS	2	45.00	120.00	350.00	50.00	565.00	
Las Vegas - TWG/EMSL Trng. ABC	5	112.50	300.00	250.00	250.00	912.50	
Las Vegas - TWG/EMSL Trng. GD	5	112.50	300.00	250.00	0.00	662.50	
Redlands-Arc/Info Sys Prog ABC	5	112.50	300.00	280.00	350.00	1042.50	
Redlands-Cart Product ABC	3	67.50	180.00	400.00	50.00	697.50	
Redlands-Geo Analysis GD	3	67.50	180.00	400.00	50.00	697.50	
Prime-Operations for Primos GD	6	135.00	360.00	400.00	100.00	995.00	
Atlanta-ERDAS GD	6	135.00	360.00	500.00	75.00	1070.00	
Misc	8	180.00	480.00	700.00	200.00	1560.00	
Totals	45	1012.50	2700.00	3880.00	1175.00	8767.50	0.00

In State

	# of Days	Food	Lodging	Transportation	Misc.	Trip Total
Bozeman	1	14.50	24.98	50.00	10.00	99.48
Bozeman	2	29.00	49.96	50.00	10.00	138.96
Missoula	1	14.50	24.98	50.00	10.00	99.48
Missoula	2	29.00	49.96	50.00	10.00	138.96
Misc	5	72.50	124.90	50.00	10.00	257.40
Totals	11	159.5	274.78	250.00	50.00	$734.28

Addendum to Table III - GIS Budget Documentation

The budget to support the development, implementation and operation of the GIS has been prepared with the following assumptions:

1. That the following expenses are essential to ongoing, baseline operations:

   A. Personnel services, including fringe benefits:
   $70,132.91

   B. Supplies and Materials:
   $8,100.00

   C. Computer Services:

      1. Training (courses necessary for effective utilization of system):
      $4,600.00

      2. PRIME system lease ($5,150/month):
      $61,800.00

      3. System maintenance:
      $24,512.00

      4. Rent:
      $1,188.00

   D. Office equipment:
   $1,100.00

   E. Travel (EMSL coordination, TWG and Steering Group participation, training courses):
   $9,502.50

   F. Communications:
   $6,336.00

2. That additional costs are necessary to effect an operational level to meet the demands expected to be placed on the GIS as identified by the GIS Task Force and the state and federal site officers; such expenses are needed to embrace the basic recommendations for system development as stated by Mr. Dan Yurman in his meeting in Helena 7-27-85 and in his report to the Director, Hazardous Waste Management Division; and, to configure the system as originally designed and insure its safe operation and security. These additional expenses are:

   A. Power Conditioners for the Prime Computer: Three power conditioners (one for each Prime cabinet) to protect the computer from electrical surges.

   B. T-Graf 07 Terminal Emulation Software: To be used on the micro-computer at the MSL. This emulation will provide an additional GIS workstation at a cost lower than the purchase of an additional terminal and will enable the GIS to use, evaluate, and develop support programs (e.g. Arc/Info AMLs) for the emulation software. This software will be used by state EPA site officers.

C. Cost Accounting Software for the Prime: The cost accounting program will be used to insure that all GIS applications using the Prime computer will be charged to the appropriate accounts. This program was recommended in the "Report on the Clark Fork Geographic Information System Project" by Dan Yurman (7-29-88).

D. Text Editor for the Prime: A text editor (word processor) for the Prime computer will be used for text generation and manipulations as well as data and program input and editing. This program was recommended in the "Report on the Clark Fork Geographic Information System Project" by Dan Yurman (7-29-88).

E. 496mb Hard Disk for the Prime: An additional hard disk for the Prime is required to handle the immense amount of graphic and tabular data involved in GIS analyses. An increase in disk storage space was recommended in the "Report on the Clark Fork Geographic Information System Project" by Dan Yurman (7-29-88). This report recommended a three-fold increase in disk storage space, however it is felt that a doubling of disk space will provide the needed capacity until the Technical Working Group (TWG) has the opportunity to evaluate the various options for system expansion.

F. Modem for the PC: The modem will be used to link the MSL micro-computer to the state of Montana mainframe computer and to other systems and databases (e.g., Map Availability Resource System of the BLM, the EIS at the Montana Department of Health and Environmental Sciences, Arc/Info electronic mail services, etc.).

G. CLAC Communications Card for the Prime: The additional communications card will provide 4 more inputs to the Prime computer for future users, peripheral equipment, and network tie-in. Additional CLAC Cards will probably be needed in the future, but it is felt that future system expansion options should be evaluated by the TWG.

These additional expenses are necessary to begin to achieve the operational status outlined by Mr. Yurman. However, the MSL and the DHES believe that further discussion is necessary before additional investments should be made (i.e. to bring the system in line with all of Mr. Yurman's recommendations). Such discussion is slated for deliberation by the Technical Working Group, who would make recommendations to the GIS Steering Committee.

Appendix B: PROJECT ACRONYMS

.AAT	Arc Attribute Table
.PAT	Polygon Attribute Table
ACS	Anaconda Mineral Company Coordinate System
AML	Arc Macro Language
ARCO	Atlantic Richfield Corporation
ASCII	American Standard Code for Information Interchange
CDM	Camp Dresser and McKee, Incorporated
CERCLA	Comprehensive Environmental Response, Compensation and Liability
CFDS	Clark Fork Data System
CFGIS	Clark Fork Geographical Information System
CFR	Clark Fork River
CFRSA	Clark Fork Record in the Sample Table
CFRST	Clark Fork Record in the Station Location Table
CFRSU	Clark Fork Record in the Survey Table
CLP	Contract Laboratory Program
CPL	Computer Programming Language
CPU	Central Processing Unit
DEM	Digital Elevation Model
DHES	Department of Health and Environmental Sciences
DLG	Digital Line Graph
DMS	Data Management System
DNRC	Department of Natural Resources and Conservation
DOA	Department Of Administration
EIS	Environmental Information System
EISRDC	EIS Records and Documents Classification Table
ELAS	Earth Resources Laboratory Applications Software
EMSL-LV	Environmental Monitoring Systems Laboratory - Las Vegas
EPA	Environmental Protection Agency
EPIC	Environmental Photography Interpretation Center
ERDAS	Raster-based image processing GIS software
ESC	Environmental System Corporation
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Administration
GIS	Geographic Information System
GPS	Global Positioning System
I/O	Input/Output or disk read/write time
IAG	Interagency Agreement
ID	User Identification
KMan	EIS software, Knowledgeman/2
LANDSAT	Satellite equipped with earth surface scanning equipment
LAP	Lab Analytical Protocol
MFD	Master File Directory
MOSS	Map Overlay Statistical System
MSL	Montana State Library
MSS	Multi-Spectral Scanner used in remote sensing
NBARS	Non-Binding Preliminary Allocation of Resources
NCC	National Computer Center, Research Triangle Park, North Carolina
NCIC	National Cartographic Information Center
NHAP	National High Altitude Aerial Photography
NOAA	National Oceanographic and Atmospheric Administration
Novell LAN	Novell Local Area Network
NPL	National Priority List

NRIS	Natural Resource Information System
OSWER	Office of Solid Waste and Emergency Response
PC	Personal Computer
PC LAN	Personal Computer Local Area Network
PRP	Potential Responsible Party
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plans
RAM	Random Access Memory
RAS	Routine Analytical Services
RI/FS	Remedial Investigations/Feasibility Studies
ROD	Record of Decision
SAP	Sampling and Analysis Plans
SAS	Special Analytical Services
SBAS	State Budget and Accounting System
SBC	Silver Bow Creek
SCAP	Superfund Comprehensive Accomplishment Plan
SIF	Standard Interchange Files
SPC	State Plane Coordinate
SPMS	Strategic Planning and Management System
SQL	Standard Query Language
STARS	Streambank Tailings and Revegetation Study
TA	Technical Assistance
TIN	Triangulated Irregular Network, ARC/INFO module for 3-dimensional analysis
TWG	Technical Working Group
USBR	US Bureau of Reclamation
USGS	US Geological Survey
UTM	Universal Transverse Mercator projection
XRF	X-Ray Florescence

Appendix C: MDHES/MSL INTERAGENCY AGREEMENT - FY89

DHES Contract No. 800254-3
Federal Catalog No. 66.802

MODIFICATION OF AGREEMENT

An AGREEMENT is hereby made between the Montana State Library's Natural Resource Information System (NRIS) and the Montana Department of Health and Environmental Sciences (DHES) for the purpose of providing support services to DHES pertaining to DHES responsibilities in the Superfund Program, including but not limited to sites at Silver Bow Creek, Montana Pole, Anaconda Smelter, and Milltown Reservoir. This AGREEMENT replaces DHES Contract No. 800254, signed and dated 9/1/87.

The parties, in consideration of mutual covenants and stipulations described below, agree as follows:

SECTION I: SERVICES

The undersigned mutually agree and understand that the purpose of this agreement is to have NRIS maintain and operate a geographic information system (GIS) for DHES. The responsibilities of NRIS include:

(1) Technical Assistance: NRIS will assess DHES and EPA needs with respect to GIS services, will evaluate available hardware and software, and will make recommendations relative to system design. NRIS will conduct feasibility studies and cost analyses. NRIS will participate in project planning with respect to choosing projects and setting priorities.

(2) Geographic Information System Management: NRIS will procure necessary hardware, software and related office equipment and train and make available staff for management of the GIS; NRIS will input, store, manipulate, and retrieve data pertinent to the sites covered by this AGREEMENT. and

(3) Interagency Coordination: NRIS will provide interagency coordination of GIS development and management.

SECTION II: DATES TO COMMENCE AND COMPLETE SERVICES

Performance of this AGREEMENT shall begin July 1, 1987, and shall end on September 30, 1989, unless this AGREEMENT is terminated earlier pursuant to SECTION VI or SECTION X. This AGREEMENT may be extended upon the mutual consent of the parties.

SECTION III: DELIVERABLES

Work products to be produced as part of this AGREEMENT include:

(1) Establish full operational capability of the system through timely acquisition and installation of hardware and software.

(2) Maintain and update quarterly a resource document describing current and planned data in the GIS, system capabilities, procedures for using the GIS, descriptions of GIS data input and analysis procedures, and other information deemed to be helpful to system users.

(3) Maintain and update quarterly an inventory of existing data sets and remote sensing information pertinent to the Clark Fork Superfund sites.

(4) Obtain, evaluate for completeness and accuracy, and install, as they become available, digital files pertinent to the Clark Fork Superfund sites produced by agencies or organizations under contract with DHES, EPA or NRIS or obtained from other sources, including but not limited to:

    (a) Data described in the EMSL work plan (Attachment 1); and,

    (b) Surveys, monitoring stations, activities and associated attribute data relating to the study area provided by DHES.

(5) Perform site specific data input as required to augment the digital files obtained from other sources.

(6) Maintain a staff of personnel trained in the use of all GIS related software and equipment available to provide data input, data management, data analysis, and data output support to EPA and DHES Superfund personnel and their contractors.

(7) Participate in the planning efforts assigned to a GIS Steering Committee; coordinate the activities of a GIS Technical Working Group (CFTWG), to:

    (a) Develop a data administration program to protect the integrity of the data in the system and to insure that QA/QC is performed in a cost effective manner.
        - Completion date - May 1, 1989

    (b) Develop a comprehensive project plan for the period ending September 30, 1991.
        - Completion date - April 1, 1989

    (c) Develop a plan for initiation of a pilot project (or multiple projects) which will effectively test all components of the system.
        - Completion date - January 1, 1989

(8) Respond in a timely manner to user requests for data analysis, and map and report generation.

(9) Coordinate GIS training activities for EPA, DHES, and other users directly associated with the Clark Fork Superfund Sites.

SECTION IV: CONSIDERATION

In consideration of services rendered pursuant to this AGREEMENT, DHES agrees to pay NRIS up to $381,935.98. Detailed budget estimates for the period from October 1, 1988 through September 30, 1989 are provided in Table 1 (Attachment 2). A summary by category of the total project budget from July 1, 1987 through September 30, 1989 is provided in Table 2 (Attachment 3). The budget ceiling established in Table 2 (Attachment 3) may not be exceeded without written amendment of this AGREEMENT.

The parties agree that the figures presented are estimates and that NRIS may increase the budget in a given category by ten percent (10%) by drawing an equal amount from other categories. Such an action by NRIS must be preceded by a notification of DHES but is not conditioned upon further approval by DHES or modification of this AGREEMENT. NRIS may procure equipment or secure services not specifically identified, valued at less than $1000.00 and deemed necessary, in order to comply with the terms of this AGREEMENT. Such an action by NRIS must be preceded by a notification of DHES but is not conditioned upon further approval by DHES or modification of this AGREEMENT as long as the total budget estimate is not increased.

Payment shall be provided for costs relating to the design and implementation of the project and for site specific services on Clark Fork Superfund sites as provided in SECTION I. Payment shall also be provided for operation and maintenance costs directly attributable to such site specific services and for a percentage of general operation and maintenance costs calculated on the basis of percent of system and personnel time and resources dedicated to Clark Fork Superfund activities during the billing period. In order to insure proper accounting of costs, the State Library shall establish separate responsibility centers on the State Budget and Accounting System (SBAS) for each Superfund site and Operable Unit as required, for general Superfund services not related to a specific site, and for all non-superfund services. Costs to each center shall be actual costs or shall be established by statistical records of resource and time allocation. The method adopted to assign costs shall be approved by DHES.

Reimbursement will be provided on a monthly basis using a draw down procedure. In the first month of the AGREEMENT, NRIS will estimate its expenditures for that month and it will submit a claim that will constitute in effect an advance for that amount of funds. Subsequent disbursement will be made on the basis of invoices submitted monthly by NRIS. Such invoices will provide an accounting of the previous month's services and expenditures and an estimate for the subsequent month. The total of the previous month's expenditures, plus the estimate, less the advance will constitute the amount of payment due. These claims and documentation shall be further substantiated by the work reports described in SECTION V. All claims for reimbursement must be approved by the appropriate State Project Officer (SPO) and Project Financial Officer. Travel expenses are established at current state per diem rates. Reimbursement for mileage will be established at applicable state rates. Communication and supply costs must be invoiced prior to reimbursement.

NRIS may renegotiate personnel services rates if necessary due to actions of the state personnel division or the state legislature which result in modification of classification or pay scale affecting personnel funded through this agreement.

SECTION V: REPORTING

The NRIS Program Director will submit a monthly report which summarizes the services provided, and will estimate the value of services to be provided in the coming month. The SPO must file the work reports in order for the NRIS to receive payment. Substantive adjustments in the level of services or type of services in any month must be approved beforehand by both the NRIS Program Director and the applicable SPO.

The summary of services provided shall be based on daily diaries kept by all project personnel which record time dedicated to the project in half hour increments. The diaries must be maintained as mandated under SECTION X.

SECTION VI: TERMINATION

Either DHES or NRIS may terminate this Interagency AGREEMENT as a result of loss of funding support or other reason. Termination may not occur before thirty (30) days written notice and an opportunity for consultation prior to termination.

Any termination of this AGREEMENT is subject to the provisions in SECTION IX pertaining to retention of and access to records.

Equipment authorized under this agreement shall be purchased, managed, and disposed of as specified by the United States Environmental Protection Agency.

SECTION VII: ASSIGNMENT AND SUBCONTRACTING

The parties agree there will be no assignment or transfer of this AGREEMENT, or of any interest in this AGREEMENT, unless both parties agree in writing. The parties agree that no services required under this AGREEMENT may be performed under subcontract unless both parties agree in writing.

NRIS agrees that no subagreement of any kind involving construction activities (including alteration or repair of any public works project) will be awarded to (a) a Japanese citizen or national; (b) a firm controlled directly or indirectly by Japanese citizens or nationals; or (c) a supplier of any product if more than 50% of the total product is allocable to production or manufacture in Japan.

NRIS further agrees that no subagreement of any kind for architecture, engineering, or other services directly related to the preparation for or performance of such construction will be awarded to a Japanese citizen or national or a firm controlled directly or indirectly by Japanese citizens or nationals.

Any solicitation of bids for subcontractable services must state that bids or proposals from such firms or suppliers shall be deemed nonresponsive and rejected.

SECTION VIII: EQUAL OPPORTUNITY

Pursuant to Sections 49-2-303 and 49-3-207, Montana Code Annotated, no part of this contract shall be performed in a manner which discriminates against any person on the basis of race, color, religion, creed, political ideology, sex, age, marital status, physical or mental handicap, or national origin by the persons performing the contract. Any hiring shall be on the basis of merit and qualifications directly related to the requirements of the particular position being filled.

SECTION IX: MODIFICATIONS AND PREVIOUS AGREEMENTS

This instrument contains the entire AGREEMENT between the parties, and no statements, promises, or inducements made by either party, or agent of either party, are valid or binding if not contained in this written AGREEMENT. This AGREEMENT may not be enlarged, modified, or altered except in writing, signed by both parties. No change, addition, or erasure of any printed portion of this AGREEMENT is valid or binding upon either party.

SECTION X: ACCOUNTING, AUDITING, RECORD RETENTION, AND ACCESS TO RECORDS

NRIS agrees to maintain records of the activities covered by this AGREEMENT and to allow access to them by DHES and, in addition, the legislative auditor as may be necessary for legislative audit and analysis purposes in determining compliance with the terms of this AGREEMENT, as required by Section 5-13-304, Montana Code Annotated. Notwithstanding the provisions of SECTION VI, this AGREEMENT may be terminated upon any refusal of NRIS to allow the access to records referred to above.

Unless otherwise agreed in writing, upon completion of this contract, financial reports, supporting documents, statistical records, and all other records documenting the cost of services provided by NRIS under this AGREEMENT must be retained for three years after the completion date specified in SECTION II. NRIS agrees to make the records described herein available at all reasonable times at its general offices. If any litigation, claim, or audit is started before the expiration of the 3-year period, the records must be retained until all litigation, claims, or audit findings involving the records have been resolved.

NRIS must provide DHES a copy of any audit covering the time period stated in Section II and complying with the audit requirements of the federal Office of Management and Budget's (OMB) Circular A-110 within 30 days after receipt from the Legislative Auditor.

NRIS agrees to account for all expenditures under this AGREEMENT in accordance with Generally Accepted Accounting Principles, the State Participation in the Superfund Remedial Program (Attachment 4) and with the provisions of OMB Circular A-87.

The State of Montana, DHES, the Environmental Protection Agency, the Department of Justice, and the Comptroller General of the United States, or any of their duly authorized representatives, have the right of access to any books, documents, papers, and records of NRIS which are pertinent to the services provided under this contract, for any purposes. Further, access shall be provided to verify cost of pricing data submitted in conjunction with the negotiation or performance of this contract or any amendments thereto. The State and DHES have the right to examine those books, records, documents, papers, and other supporting data which involve transactions related to this AGREEMENT or which will permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used in them. Public access to records shall be provided with the consent of the SPO and shall be subject to the Montana/EPA Confidentiality of Documents Memorandum of Understanding (Attachment 5).

The original copies of records and files pertaining to the services provided under this AGREEMENT will be forwarded to DHES for appropriate disposition, after the expiration of the three-year retention period.

SECTION XI: SEVERABILITY

It is understood and agreed by the parties hereto that if any term or provisions of this contract is held to be illegal or in conflict with any Montana law by the courts, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the contract did not contain the particular term or provisions held to be invalid.

SECTION XII: INDEPENDENT CONTRACTOR STATUS

The parties to this AGREEMENT intend that the relation between them created by this contract is that of independent state agencies. Neither NRIS nor any agent, employee, or servant of NRIS shall be or shall be deemed to be the employee, agent, or servant of DHES. The State Library will be solely and entirely responsible for its own acts and/or the acts of its employees, agents, and servants, during the performance of this contract.

SECTION XIII: SPECIAL CONDITIONS

A. Any discovery or invention made, or data or text developed, or under development, as a result of work conducted under this AGREEMENT is subject to EPA requirements and regulations pertaining to reporting and patent rights, and to those contained in 40 CFR Part 30 relating to copyrights and rights in data.

B. STANDARD PERFORMANCE AND LIABILITY

1. NRIS is responsible for the professional quality, technical accuracy, timely completion, and coordination of all designs, drawings, specifications, reports, and other services furnished by NRIS under this AGREEMENT. NRIS shall, without additional compensation, correct or revise any errors, omissions, or other deficiencies in its designs, drawings, specifications, reports, and other services when said errors, omissions, or other deficiencies are not a result of incomplete or inaccurate data supplied to NRIS.

2. DHES' or EPA's approval of drawings, designs, specifications, reports, and incidental work or materials furnished hereunder shall not in any way relieve NRIS of responsibility for the technical adequacy of its work. Neither DHES' or EPA's review, approval, acceptance, or payment for any of the services may be construed as a waiver of any rights under this AGREEMENT or of any cause of action arising out of the performance of this AGREEMENT.

C. All documents and other work products of NRIS for this PROJECT are instruments of service for this PROJECT only, whether the PROJECT is completed or not. Reuse by DHES of any of the instruments of service of NRIS on extensions of the PROJECT, or on any other project, shall be at DHES' sole risk and without liability for reuse or legal expense to NRIS. All work products provided to DHES shall become the sole and separate property of DHES and cannot be used by NRIS without written permission of DHES.

D. NRIS shall comply with all federal, state, and local laws, regulations, and ordinances applicable to the work to be done under this AGREEMENT.

E. Should NRIS's work as specified within this AGREEMENT be found to be inadequate or performed in a negligent or incompetent manner by a court of law, an arbitrator or an auditor, the State shall be reimbursed by NRIS for the money paid to NRIS for the particular task found to be inadequate or negligently or incompetently performed.

SECTION XIV: REMEDIES

Unless otherwise provided in this AGREEMENT, all claims, counterclaims, disputes, and other matters in question between DHES and NRIS arising out of, or relating to, this AGREEMENT or breach of it will be decided by binding arbitration if the parties mutually agree, or by the First

Judicial District Court in and for the County of Lewis and Clark in Helena, Montana. In either case, the laws of the State of Montana shall be used.

SECTION XV: LIAISONS

The NRIS liaison to DHES for purposes of this agreement is Jon C. Sesso, his successor or a designee made by the State Librarian. DHES's liaison to NRIS for purposes of this AGREEMENT is James L. Hill, or his successor.

SECTION XVI: EXECUTION

This AGREEMENT consists of nine (9) pages and five (5) Attachments. The original is to be retained by the Centralized Services Division of DHES. A copy of the original has the same force and effect for all purposes as the original.

MONTANA STATE LIBRARY

9-30-88
Date

BY: Debbie Schlesinger
DEBBIE SCHLESINGER
State Librarian

Justice Building
Helena, MT 59620

DEPARTMENT OF HEALTH AND
ENVIRONMENTAL SCIENCES

9-30-88
Date

BY: Charles F. [illegible] for
RAYMOND J. HOFFMAN
Administrator, Centralized
Services Division

Approved for legal content by:

T Eggert
Tom Eggert
DHES Counsel

9/30/88
Date

TABLE I

Interagency Agreement - DHES/MSL

Geographic Information System Component
Budget Period October 1, 1988 - September 30, 1989

A. Personnel

Title	Grade /Step	Hourly Rate	Hours	Salary Cost	Benefits @ 0.22	Salary + Benefits	Category Totals
NRIS Director	16/6	13.239	832	11014.85	2423.27	13438.12	
GIS Director	15/2	11.167	2080	23227.36	5110.02	28337.38	
GIS Research Assistant II	11/2	8.079	2080	16804.32	3696.95	20501.27	
Library Technician	9/3	7.144	520	3714.88	817.27	4532.15	
Accountant	14/8	11.846	230	2724.58	599.41	3323.99	
Total Personnel							$70,132.91

B. Materials & Supplies	Qua.	Unit Cost	Total	Category Totals
Office Supplies	12	175.00	2100.00	
GIS Supplies	12	375.00	4500.00	
Photocopies	12	25.00	300.00	
Resource Document Updates	4	300.00	1200.00	
Total Materials				$8,100.00

C. Computer Services & Equipment	Qua.	Unit Cost	Total
Electrical Line Conditioner	3	1500.00	4500.00
Off-site back-up tape storage 72 tapes @ .45/tape/month = 32.40	12	32.40	388.80
Box Storage at ISD	12	14.80	177.60
PC Software Programs			650.00
T-Graf 07 Emmulation Software	1	1000.00	1000.00
Cost Accounting Program for Prime	1	600.00	600.00
Text Editor for Prime	1	3500.00	3500.00
496mb Hard Disk for Prime	1	15000.00	15000.00
Modem for PC	1	500.00	500.00
CLAC Communications Card (4 lines each)	1	375.00	375.00
Misc. Computer Equipment (cables, switch boxes, etc.)			1000.00
TRAINING:			
PRIME Courses:			
1. Intro to Computing on a PRIME	1	1100.00	1100.00
ESRI Courses:			
1. ARC/INFO System Programming	1	1000.00	1000.00
2. Cartographic Production	1	500.00	500.00
3. Geographic Analysis	1	500.00	500.00
ERDAS Training	1	500.00	500.00
Miscellaneous Courses			1000.00 110
MSL Rent (400 sq. ft./month)	12	99.00	1188.00
System Lease (monthly rate) (Includes hardware & software)	12	5150.00	61800.00
Maintenance (monthly after warranties expire)			
Hardware (Prime)	12	1067.00	12804.00
ERDAS SSS	12	166.67	2000.00
FORTRAN 77	12	72.00	864.00
ARC/INFO	3	600.00	1800.00
CalComp (Digitizer & Plotter)	12	253.00	3036.00

Add: LogTime
Maintenance
Arc/Info object
maintenan

ATTACHMENT 2 (CONTINUED)

Tektronix Terminals (2 @ 75/month)		12	150.00	1800.00	
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Total Computer Services					$119,791.40
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Light Table		1	500.00	500.00	
Total Office Equipment					$1,100.00
E. Travel					
In State				735.00	
Out of State (EMSL, Training Courses, etc.)				8767.50	
Total Travel					$9,502.50
F. Communications		Qua.	Unit Cost	Total	
a. Basic Service (Mainframe)		12	150.00	1800.00	
b. Telephone Service					
Basic Service (4 lines)	48.00	12		576.00	
Use - $16.50 per hour					
@ 20 hours per month	330.00	12		3960.00	
Total Communications					$6,336.00
Grand Total					$214,962.81

TABLE I-A

CLARK FORK COOPERATIVE AGREEMENT

GIS Component Travel Budget
Budget Period October 1, 1988 - September 30, 1989

Out-of-state

Trip Desc	# of Days	Food	Lodging	Transport	Misc.	Trip Total
Denver TW	2	45.00	120.00	350.00	50.00	565.00
Denver St	2	45.00	120.00	350.00	50.00	565.00
Las Vegas	5	112.50	300.00	250.00	250.00	912.50
Las Vegas	5	112.50	300.00	250.00	0.00	662.50
Redlands-	5	112.50	300.00	280.00	350.00	1042.50
Redlands-	3	67.50	180.00	400.00	50.00	697.50
Redlands-	3	67.50	180.00	400.00	50.00	697.50
Prime-Ope	6	135.00	360.00	400.00	100.00	995.00
Atlanta-E	6	135.00	360.00	500.00	75.00	1070.00
Misc	8	180.00	480.00	700.00	200.00	1560.00
Totals	45	1012.50	2700.00	3880.00	1175.00	8767.50

In State

	# of Days	Food	Lodging	Transport	Misc.	Trip Total
Bozeman	1	14.50	24.96	50.00	10.00	99.46
Bozeman	2	29.00	49.92	50.00	10.00	138.92
Missoula	1	14.50	24.96	50.00	10.00	99.46
Missoula	2	29.00	49.92	50.00	10.00	138.92
Misc	5	72.50	124.80	50.00	10.94	258.24
Totals	11	159.50	274.56	250.00	50.94	$735.00

Grand Tot $9,502.50

Appendix D: CLARK FORK DATA MANAGEMENT SYSTEM DATABASE STRUCTURE

System Origins

The Environmental Information System (EIS) has developed as a result of an effort to place environmental data management on a sound framework for continuing development and to make the operator interface easier for the user. The EIS is designed to provide the data administrator with a data model with data organizational and data integrity tools, and to step a user through the system in a logical manner to accomplish basic tasks such as: finding, modifying, listing, reporting and plotting data. The EIS was initially implemented in the personal computer environment for the Commencement Bay Superfund project in Puget Sound, was then modified and extended to handle Superfund projects in the Clark Fork River Basin in Montana. It has been extended to handle a wide variety of environmental and organizational data and to include most of the database engine command possibilities within a menu driven interface.

The EIS has evolved to try to integrate the many types of information management needs associated with a complex environmental project. The surface water portion of the system has its roots in the Reach File developed for the EPA in 1979. The Reach File helped pioneer the concept of dividing the nations surface waters into segments or reaches, for which characteristic data could then be associated. The Reach File originally was based on the streams appearing in the NOAA 1:500,000 map set, and is currently being revised in some parts of the nation (including the Columbia River Basin) to include streams on the 1:100,000 map set. The idea of organizing and defining surface water structures was then used as part of the development of the Environmental Master Guide system for the Alaska Gas Pipeline in 1981, and for the Commencement Bay and Anaconda Superfund projects.

The activity portion of the system has its roots in the Industrial Facility Profile database developed for EPA in 1978, and was extended to cover a wide variety of activities associated with the Alaska Gas Pipeline. With the increasing use of spatial information handling systems the definition of activity is tending toward representing the entities existing as layers in an associated GIS. The layers generally include those defined by USGS DLG specifications, including: political and administrative areas, cultural features, transportation and utility systems, and public lands areas.

The survey, station, sample portion of the system structure has its roots in the NOAA National Oceanographic Data Center System.

The observation portions of the system were organized according to the typical methods for field and laboratory analysis. For example, data that tends to be grouped together on a laboratory results sheet was grouped together in the system.

The document portion of the system has its roots in the Record and Document Management System developed by Boeing.

Relational Database Structure

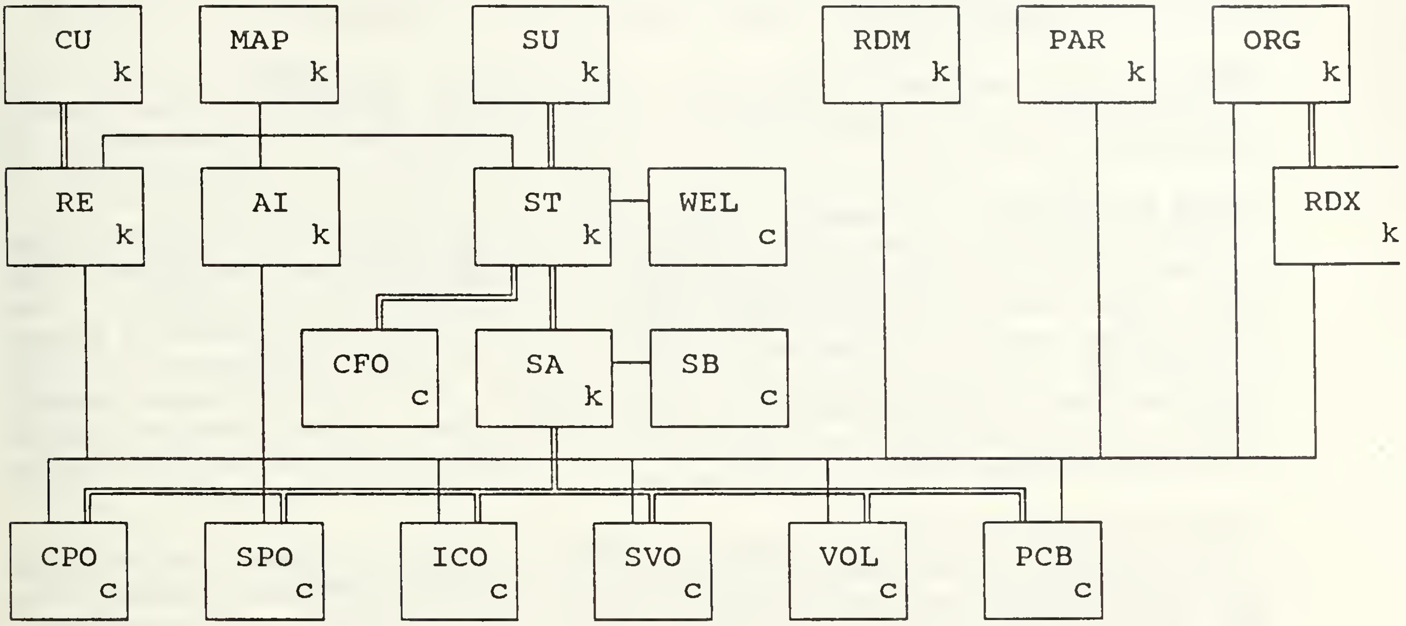
The EIS structures information according to relational database concepts. Information in a relational database system is organized into "Normal Form" to simplify understanding, and make queries and changes consistent. Data in the EIS have been logically modeled into Third Normal Form, where data items in a logical record are made functionally dependent on the primary key of that record. For example, a relational database handling parents and children places all the parents and their characteristics in one file and all the children and their characteristics in another file. Each child can be linked to its parent by using the respective unique parent field value (primary parent key field).

Basic entities are defined and organized according to their primary relationships. Information characterizing each type of entity is structured as a two-dimensional table. Each row in the table is called a record or entity member and each column is called a field or attribute. Each cell in a table is called a data element or data item. Entity relationships are explicitly defined using pointers to the key field in the related table. Entities may have a one-to-one, or many-to-one relationship to each other. Entities with many-to-many relationships are decomposed to a simpler form to conform to the relational model.

The relational database model defines: domains and relations as object types, operations on these object types, and integrity rules. The EIS defines the following relations and domains:

EIS Relation	Code	Domain
Subjects	RE, etc.	All entity instances for each subject
Directory	DI	All existing directories
File	FIL	All existing files
Table	TDI	All subject files
Attribute	FDI	All characteristics of entities
Fields	FLD	All attributes of subjects
Rules	RUL	All attribute domain names
Option	OPT	All operator interface options
View	VEW	All operator views of interest
Commands	COM	All recently entered commands
Bad values	BAD	All field values failing rules test
Chemicals	CHEM	All chemicals and compounds of interest

ENVIRONMENTAL INFORMATION SYSTEM ENTITY CHART



CU - Cataloging Unit
RE - Surface Water Reach
AI - Activity
SU - Survey
ST - Station
WEL - Well characteristics
SA - Sample
SB - Sample Batch
SIM - Sample identification matrix
CFO - Field Observation
CPO - Conventional Water Data
SPO - Conventional Solids Data
ICO - Inorganic Chemical Data
SVO - Semi-Volatile Organic Chemical Data
VOL - Volatile Organics Data
PCB - Pesticides and PCB Data
MOO - Miscellaneous Organic Chemical Data
RDM - Records and Document Management
RDX - Rolodex (person directory)
ORG - Organization Directory
PAR - Parameter Codes
MAP - Maps

DATA DICTIONARIES

Several tables are defined to handle database dictionary information. The structure of this information is presented in Figure 2.

A **DOS directory dictionary table (DI)** is used to store the relation between a file and the path to the directory storing the file. The DI table has two fields or attributes: Name and Directory. The Name field refers to the code name assigned to a database (a group of related table, forms and programs) or an activity such as word processing. The Directory field refers to the DOS path which locates the files related to the database name. The directory path value can be changed by the system manager by changing the value of the Directory field and then moving all the corresponding files.

A **Menu format dictionary table (MEN)** is used to store the format for each menu. Each menu can display a form (FORMNAME) along with the menu. The database manager defines menu names and formnames. The database operator can adjust Menu table field values to modify the size and location of the menu on the display.

An **Option dictionary table (OPT)** is used to store the options for each menu.

A **Table dictionary table (TDI)** is used to store table parameters for use by various programs. The Table dictionary table is under control of the database manager. The TDI table field values are used by various programs to relate processing operations to each table.

FILE STRUCTURE

All Knowledgeman executable programs (files with .EXE suffix on file name) reside in a directory called "\K205" or any other directory to which a path has been established by the operating system. Overlays (programs with .OVL suffix on file name) and programs and libraries (.IPF and .ILB extensions) reside in a directory called "\DB". The main Kman program is executed using a DOS batch file executed through a menu interface. The batch file sets paths to related directories, copies the appropriate drivers, sets the monitor mode, etc. To establish the identity and security level of the user, a user password (KPASS.IGU) file containing read/write access codes for each user is executed once the main program starts. An auto-executable procedure (STARTUP.IPF) file is then used to display logos, load library files and start the EIS.

Each type of information is grouped into a set of related tables called a database. For example, all information associated with one project would typically be defined as a database. Each database is listed on the database menu and can be selected by the operator. Many different collections of information may be defined

Figure 1: Structure of Dictionary Data Tables

DI DIRECTORY DICTIONARY

NAME	DIRECTORY	DESCRIPTION
EIS	C:\DB\EIS	General Environmental
AMC	C:\DB\AMC	Anaconda
CFR	C:\DB\CFR	Clark Fork River
WP	C:\WP	Word Processor
.	.	

MEN MENU DICTIONARY

NAME	FORMNAME	MWIDTH	CROW	CCOL	HEIGHT	MNUMOPT
DBO	STANDARD	30	15	40	5	5
CFR	STANDARD	70	1	40	14	25
.	.	.	.	.	.	.

OPT MENU OPTION DICTIONARY

MENU	NAME	ORDER	TYPE	ACTION	DESCRIPTION
DBO	AMC	1	M	AMC	Anaconda
DBO	CFR	2	M	CFR	Clark Fork River
.	.	.	.	.	.
AMC	CU	1	P	TRO	Cataloging Unit
AMC	AMCRE	3	P	TRO	Surface Water Reach
.	.	.	.	.	.
CRF	CRFICO	10	P	TRO	Inorganic Chemicals

TDI TABLE DICTIONARY

NAME	FORMNAME	PAGES	KEY1	KEY2	PARENT	DESCRIPTION
EISC	EISCU	1	CU	NAME		Catalog Units
CFRRE	EISRE	1	RE	NAME	EISCU	CFR Reach File
CFRSU	EISSU	1	SU	NAME		CFR Surveys
.	.	.	.	.	.	

and listed on the database menu. Once the operator selects a database for use, the system establishes paths to the directory locations of all related database tables and procedures for operating on those tables, and displays a Table selection menu.
Tables and procedures shared by more than one database are placed in a common location. Table, procedure, and other files used by essentially all databases are placed in a general ("\DB") directory. Files used by essentially all environmental databases are placed in a general Environmental Information ("\EIS") directory. Files used by a specific database are placed in a directory for that database. This strategy saves space, minimizes maintenance, and ensures synchronization of common data and operations.

Each type of system capability is grouped into a set of procedural operations called functions. These functions are designed to perform similar operations on data no matter what the data type or database being used. For example, operations associated with finding a record, adding a record, and modifying a record are grouped together. New functions can be added to the system as needed and placed on the function selection menu.

SUBJECT DATA MODELS

Subject data models are defined within the relational data model framework. Subject data model objects are relational tables which define the various data types of interest including:

- Physical world data (hydrologic, topography, land use, utilities, transportation)
- Discipline data (physical, chemical, biological)
- Project data (surveys, stations, samples, observations)
- Legal data (ownership, administration)
- Organizational data (organizations, people, documents)
- Data administration data (tables, directories, files, fields)

CU - Cataloging Unit

The highest level drainage identifier is the cataloging unit (CU). The concept of the CU was developed by the U.S. Geological Survey to delineate major watersheds in the United States. The CU table in the Environmental Information System currently contains definitions and descriptions of cataloging units in the states of Washington, Idaho and Montana. Each record defines a unique cataloging unit identified by an eight-digit code. Example: the Upper Clark Fork, Montana Unit is coded as 17010201. This entity provides a framework for organizing drainages anywhere in the United States. The size of a cataloging unit drainage area is typically 100-500 square miles.

RE - Surface Water Reach

The second level of drainage identifier is the surface water reach (RE). A surface water reach is a subdivision of a Cataloging Unit that provides enough detail for project data management needs. Reaches are the same as those defined by the EPA Reach file. In some cases, it may be necessary to define project reaches which are not in the EPA file. In this case, new reaches can be defined using the Reach File method of identification. The definition of new reaches should be communicated to EPA MDSD so that the master Reach file can be updated to reflect the additions. For example in the Anaconda area, many of the surface water reaches are based on the results of a 1983 study by Anaconda which defined all important streams, ditches and drains.

ID numbers and descriptions of reach objects form the basis of the RE table. The RE table contains one record defining each surface water reach. Each reach is identified by a code composed of the CU number plus a three digit reach number code plus a five-digit subreach code. The subreach code allows subunits, pipes or tributaries of a reach to be identified.

Most data in the Environmental Information System are linked to a surface water segment. When a sampling station is located in space and coded for entry into the database, the drainage segment along which the station is located is identified. This information will be transferred automatically to the sample table, and from there to all of the data tables where observations made at that station are stored. It is then possible to retrieve data from any data table based on the cataloging unit, basin or surface water segment.

AI - Activity

It is often of interest to store information about various kinds of activities occurring in a project area (e.g., industrial or government actions, processing operations, dump sites, dredging projects, spills). The Activities table (AI) provides the ability to organize information according to primary type of activity causing or receiving impacts.

The AI table in the Environmental Information System contains one record defining each activity of interest. An activity has a location in space and takes place during a defined time period. Each activity is identified by a code of up to eight digits. For example, AMC002 is the Anaconda Stack Slag Dump in a gulch on the north side of Weather Hill.

The activity number also appears throughout the database and can be used to relate data to an activity. The ACTIVITY field, which is found in most tables, contains the code of the activity to which the data refers.

SU - Survey

The highest level observation identifier is the survey. A survey is a research effort taking place during a period of time, conducted by a researcher, agency, or company. Each record in the SU table defines and describes a unique survey, identified by an eight digit code. The Survey entity provides the ability to organize information according to a particular organizational effort. Coding of the primary key is arbitrary. However, it may be useful to structure the key using the first four characters to define a project effort and the last four characters to define a survey type and serial number. This will make it easier to retrieve samples based on a project or type of survey.

ST - Station

The next level at which observation data are defined is the station (ST). Within each survey, every location where a sample was taken or a measurement was made is identified as a station. A station can be a point, a line, or a transect. Each record in the ST table defines and describes a station, identified by an eight-digit survey code plus a five-digit station code. An example of a station is HES001 AN-01, which is a point in Anaconda on the Lincoln School grounds at Plane coordinates 1126700,792000 with an accuracy of 50 ft. The Station entity provides the ability to organize information spatially (i.e., retrieve all data near a particular coordinate or plot data according to relative locations).

WEL - Well

This entity provides the ability to record and retrieve additional descriptive information about stations which are wells.

SA - Sample

Below the station level is the sample (SA) identifier. A Sample is a definable fraction or composite of material taken at a particular station for detailed analysis or observation. Samples may be grouped by using the concept of subsample or split using the concept of replicate or both. This entity provides the ability to relate laboratory data to a particular portion of material collected, and to understand the origins or nature of that material.

The SA table in the Environmental Information System contains one record defining each sample. The sample is identified by a code composed of the survey number plus the station number plus a seven-digit sample code. The sample code itself allows subsamples or portions of a sample to be identified. An example of a sample is HES001 AN-01 SO-16, a soil sample collected by scoop at station AN-01 on 12/19/84 at 16:00 hrs and sent to Cal Analytical Lab.

Most data in the Environmental Information System are linked to a sample by these identifiers. When data are coded for entry into the database, values for the SURVEY, STATION, and SAMPLE fields of that record are coded. When a record is entered, the database will automatically check to verify that such a sample exists in the SA table. This ensures that all data are adequately and correctly identified. It is then possible to retrieve data from any data table based on the survey, station, or sample.

ISB - Sample Batch

Identifies the laboratory sample batch. This entity provides the ability to record and retrieve QA/QC data for any sample batch, and consequently for any sample. (The ISB table is in the prototype stage at this time.)

CAS - Case

Identifies the Case to which the sample belongs. This entity provides the ability to record and retrieve chain of custody and related documentation for any case, and consequently for any sample. (The CAS table is in the prototype stage at this time.)

CFO - Field Observation

An observation made at a particular station using field equipment. This entity provides the ability to record and retrieve field conditions at a particular point in time and space.

AIR - Air Inorganic Chemicals

An observation made at an air sampling station. This entity provides the ability to record and retrieve data associated with air samples at a particular point in time and space.

MET - Meteorological Observation

Meteorological observation made at using field equipment. This entity provides the ability to record and retrieve meteorological conditions at a particular point in time and space.

CPO - Conventional Water Data

Results of conventional laboratory analysis on a particular water sample. This entity provides the ability to record and retrieve conventional water quality variables associated with a particular sample.

SPO - Conventional Solids Data

Results of conventional laboratory analysis on a particular solids sample. This entity provides the ability to record and retrieve conventional solids associated with a particular sample.

SGO - Grain Size Solids Data

Results of laboratory grain size analysis on a particular solids sample. This entity provides the ability to record and retrieve grain size variables associated with a particular sample.

ICO - Inorganic Chemical Data

Results of inorganic chemical laboratory analysis on a particular sample. This entity provides the ability to record and retrieve inorganic chemical variables associated with a particular sample.

OCO - Organic Chemical Data

Results of organic chemical laboratory analysis for U.S. EPA acid extractable and base/neutral priority pollutants and hazardous substances on a particular sample. This entity provides the ability to record and retrieve certain organic chemical variables associated with a particular sample.

VOL - Volatile Organics Data

Results of organic chemical laboratory analysis for U.S. EPA volatile priority pollutants and hazardous substances on a particular sample. This entity provides the ability to record and retrieve certain organic chemical variables associated with a particular sample.

PCB - Pesticides and Pcb Data

Results of organic chemical laboratory analysis for U.S. EPA pesticides and PCB priority pollutants on a particular sample. This entity provides the ability to record and retrieve certain organic chemical variables associated with a particular sample.

TIO - Organic Chemical Data - Tentatively Identified Compounds

Results of organic chemical laboratory analysis of a sample for certain tentatively identified compounds of interest. This entity provides the ability to record and retrieve certain organic chemical variables associated with a particular sample.

NPO - Organic Chemical Data - Other Non-Priority Pollutants

Results of organic chemical laboratory analysis for other compounds on a particular sample. This entity provides the ability to store, in a flexible format, certain organic chemical variables associated with a particular sample and not stored in other data tables.

BIO - Bioassay Data

Results of a bioassay on a particular sample. This entity provides the ability to record and retrieve biological responses associated with a particular sample.

CSO - Community Structure Data

Results of identification of benthic organisms and analysis of benthic community structure of a particular sediment sample. This entity provides the ability to record and retrieve biological community variables associated with a particular sample.

PAO - Pathology Data

Results of analyses of biological samples for lesions and other abnormalities. This entity provides the ability to record and retrieve certain pathology variables associated with a particular sample.

RDM - Records and Document Management

The Records and Document Management (RDM) table in the database stores information that identifies each document. Each record in the RDM table defines and describes a document, which is identified by an accession number. This document number is a none-digit code consisting of the first four letters of the primary author's name or organization code, a three-digit accession number, and a two-character code indicating revision level and revision number. An example of a document number is WDOE066F, which the 66th document recorded whose source is the Washington Department of Ecology.

The document number is also used throughout the database to cite the original source of the information. The DOCUMENT field, which is found in every record in every table (except of the dictionary tables described below), contains the document number and the page of the document from which the information in that record was obtained. A user with questions about the data can then locate information about the document in the RDM table or find the document itself in the library.

RDC - Document Classification

The Records and Document Classification (RDC) table stores information which classifies documents by type of document, subject areas, types of material, and geographic areas covered in the document.

RDX - Rolodex

A person associated with a project (e.g., project or task managers, consultants, subcontractors). This entity allows a person to be identified, located, and classified with respect to related project tasks or activities.

ORG - Organization Directory

An organization associated with a project (e.g., document sources, consultants, subcontractors). This entity allows an organization to be identified, located, and classified with respect to related project tasks or activities.

PAR - Parameter Definition

A code definition for codes used in other tables. This entity defines the allowable values for coded fields, and allows fields to be classified using a limited and specified number of options.

TAX - Taxonomic Code Definition

A code definition for codes associated with taxonomic attributes of samples. This entity defines the domain for coded fields, and allows organisms to be identified using a standardized system of classification.

Appendix E: HARDWARE AND SOFTWARE VENDOR CHART

SOFTWARE

Name	Address
ARC/INFO	Environmental Systems Research Institute, Inc., 380 New York Street, Redlands, California 92373; (714) 793-2853
CROSSTALK	Microstuf, Inc., 1000 Holcomb Woods Parkway, Suite 440, Roswell, Georgia 30076
EZTAPE	Irwin Magnetic Systems, Inc., 2101 Commonwealth Blvd., Ann Arbor, MI 48105
EIS	Environmental Systems Corporation, 8042 171st Avenue, NE, Redmond, Washington 98052; (206) 882-1221
ERDAS	Advanced Technology Development Center, 430 Tenth Street NW, Suite N206, Atlanta, Georgia 30318; (404) 872-7327, TELEX 706327
FASTBACK	Fifth Generation Systems, 7942 Picardy Avenue, B-350, Baton Rouge, Louisiana 70809; Technical support (800) 228-6127, Sales (800) 225-2775
KNOWLEDGEMAN/2	Micro Data Base Systems, Inc., Lafayette, Indiana, 37902
LOG_TIME	Computronics, 4N165 Wood Dale Road, Addison, Illinois 60101; (312)941-7767
LOTUS	Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, Massachusetts 02142
	Lotus Development Center, P.O.Box 371934, Pittsburg, Pennsylvania 15251
PRIMOS	Prime Computer, Inc., Prime Park, Natick, Massachusetts 01760; (800)343-2320 Customer support
TGRAF-07	Graphpoint, 1485 Saratoga Avenue, Sam Jose, California 95129-4934; (408) 446-1919
WORDPERFECT	WordPerfect Corp., 288 West Center Street, Orem, Utah 84057; (801) 225-5000 or 226-6800, TELEX 820618 WPC, FAX (801)227-4288

HARDWARE

Name	Address
BLACK BOX	Black Box Corp., Mayview Road, Lawrence, Pennsylvania 15055; (412) 746-5500
CALCOMP	CalComp, 2411 La Palma, Anaheim, California 92801 (service address); 821-2183
COMPAQ	Compaq Computer Corp., 20555 FM 149, Houston, Texas 77070; (713) 370-0670
IBM	IBM Corp., P.O.Box 1328-W, Boca Raton, Florida 33432

IRWIN	Irwin Magnetic Systems, Inc., 2101 Commonwealth Blvd., Ann Arbor, MI 48105
PRIME	Prime Computer Inc., P.O.Box 14136, Spokane, Washington 99214; (509) 926-3110
	Prime Computer, 19800 MacArthur Boulevard, Irvine, California 92715
TEKTRONIX	Tektronix Inc., Howard Vollum Park, P.O.Box 500, Beaverton, Oregon 97077
ZENITH	Zenith Data Systems, Hilltop Road, St. Joseph, Michigan 49085; (616) 982-3700

Appendix F: WORK ORDER DATA SPECIFICATIONS

SECTION I DATA MANAGEMENT PLAN: A. <CONTRACTOR> will prepare a Data Management Plan (DMP) for the project. The DMP will document how <CONTRACTOR> will record and manage data collected. Specifically, the DMP will detail compliance with Sections II through IV below.

B. <CONTRACTOR> will submit the DMP for review a minimum of sixty days prior to commencement of data collection and will modify the DMP as directed to insure compatibility with the Clark Fork Data System, and to provide for expeditious incorporation of data into the system.

SECTION II REPORTING: A. [Insert wording here to set forth the schedule for submission of data (i.e. "Upon completion of the contract..."; "At the intervals specified...";etc)], <CONTRACTOR> will submit accumulated data and accompanying documentation to [insert wording here to describe who is to receive data (i.e. SPO/RPM/Data System Administrator/GIS Officer).

B. Except as noted under SECTION II (C), data will be submitted in machine readable format as follows:

1. High or low capacity 3½" or 5¼" diskette. Data may be loaded to diskette using a PC DOS compatible backup utility with advance approval from the data system administrator.

2. Data cartridges compatible with Irwin Magnetic Systems tape drive Model 265, loaded using Irwin Magnetic EzTape version 1.3 or fully compatible alternate.

3. Digital map coverage data to be communicated directly to the GIS may be provided on 9-Track computer tape @ 1600 or 3200 bpi.

C. [Insert special conditions here which would allow for data to be submitted in hard copy only.]

SECTION III DOCUMENTATION: The following documentation shall accompany all data submitted for inclusion in the data system:

- Name of responsible agency or company
- Contact name and address
- Fully completed coding forms (unless data is provided in machine readable format)
- Maps and explanations of all map data codes
- Relevant field notes.
- Method of data input (e.g., manual typing)
- Field definitions for fields not defined within the Clark Fork Data System
- Range of data values (min/max)

The following additional documentation shall accompany all map data in digital format submitted for inclusion in the data system:

- Date of creation
- Method of data input (e.g., digitized, scanned, etc.)
- Specifications of equipment used (e.g., digitizer resolution: 1/1000")
- Map source (e.g., USGS 7½ minute Topographic Quadrangle)
- Map medium (e.g., paper, mylar, etc.)
- Map Scale/Projection
- Registration tics used
- Processing and post-processing software used

ATTACHMENT A

SPECIFICATIONS FOR SUBMISSION OF DATA FOR INCLUSION IN THE CLARK FORK DATA MANAGEMENT SYSTEM

The State of Montana Department of Health and Environmental Sciences has selected the Environmental Information System (EIS) for use in fulfilling the data management objectives with respect to the Upper Clark Fork River Superfund Sites. The Environmental Information System is a set of table, form, and program files developed by M. D. Swayne that implements data, integrity and operator models. The EIS provides: a data model appropriate to managing a wide variety of environmentally related information, an implementation of this model using a modern data base engine in a personal computer environment, and an operator interface which facilitates routine data management tasks such as data entry, retrieval, reporting and integrity checking.

SYSTEM COMPATIBILITY DEFINITION

It is important that organizations collecting data destined for the Clark Fork Data System and/or desiring to use Clark Fork Data System data develop or use a compatible data management function.

Compatibility can be defined with respect to three levels:

1. Data model definition
2. Data model implementation
3. Operator interface

Compatibility at the data model definition level is required. Compatibility at the data model implementation and operator interface levels provides greater utility and efficiency but is not required.

EIS DATA MODEL DEFINITION COMPATIBILITY

Compatibility with respect to EIS data model definitions is required to ensure that data is defined in the same manner to ensure accurate, explicit and efficient data transfer. The following is a list of EIS data models together with compatibility requirements:

A. Conceptual model - Relational data base - Required.

   The relational data model is the overall conceptual data structuring device for the EIS. The relational data model is a general mathematical model which can be used to organize any type of information. The relational model defines: domains and relations as object types; update, retrieval and viewing operators; and valid state, and transaction monitoring integrity rules. Other conceptual data models, such as hierarchical or network models, that use pointers to link records are not directly compatible with the EIS. Data communication between relational and non-relational systems requires restructuring which can be tedious and time consuming.

B. Subject data models - One or more relational tables - Required.

   The EIS defines subject environmental data models within the relational data model framework. Subject data is required to be organized and stored according

Data integrity is systematically checked by the data system. However, it is desirable that data imported into the system have been previously checked to reduced the iterations required to establish integrity. For example, any data not found to have integrity will be flagged as unusable. Fields and field values that refer to domain names or domain values not defined require the data system administrator to contact the data originator to make changes. Data that does not conform to the integrity model will not pass the integrity checks cannot be made available for retrieval.

DATA MODEL IMPLEMENTATION COMPATIBILITY

The EIS data model is implemented using a standard relational data base software called Knowledgeman (KMan) v2.05 (Micro Data Base Systems, Inc., Lafayette, In), which runs on IBM PC compatible computers under PCDOS. It is not required that the data model be implemented using the EIS or Knowledgeman; however, absolute compatibility can be achieved through implementation using the EIS and Knowledgeman, both of which are available commercially.

It is required at this time that the data models be implemented in an operating system environment capable of importing and exporting PCDOS compatible relational table files in any of the following formats:

REQUIRED EXPORT CAPABILITY

- KMan table files, or
- dBASE II or dBASE III table files, or
- SDF files (fixed columns, no delimiter, one line corresponds to a record), or
- ASCII files (variable columns, any unique character delimiter, with one line corresponding to one record).

REQUIRED IMPORT CAPABILITY

- KMan table files, or
- SDF files (fixed columns, no delimiter, one line corresponds to a record), or
- ASCII files (variable columns, any unique character delimiter, with one line corresponding to one record), or
- ASCII files (one field/expression value per line, strings quoted, and records delimited by blank lines), or
- Unquoted ASCII files (one field/expression value per line, strings unquoted, and records delimited by blank lines), or
- DIF (Data Interchange Format) files (see Technical note SATN-10, 1980, Software Arts, Inc.), or
- BASIC files (Logicals equal 1 for TRUE and 0 for FALSE, strings are double quoted, numbers have leading blank for positive values and

ATTACHMENT B

SPECIFICATIONS FOR SUBMISSION OF DATA FOR INCLUSION IN THE CLARK FORK GEOGRAPHIC INFORMATION SYSTEM

It is preferred that spatial data and their attributes are transferred to the GIS as ARC/INFO map coverages. Other acceptable data formats are: USGS Digital Line Graph (DLG-3 Optional format); ERDAS GIS Files; MOSS; and DIME. Attribute codes used for the map coverages should conform to the specifications outlined in Appendix F, Section III. Any exceptions should be documented.

Data may also be submitted in the form of ASCII files. The GIS project can automatically convert ASCII data to ARC/INFO point coverages if they are in the format given below. Specific information for line or polygon data input may be obtained by contacting the Clark Fork GIS staff at the Montana State Library, 1515 East 6th Avenue, Helena, MT 59620. Contact Allan Cox, GIS Officer, at (406) 444-5357.

INSTRUCTIONS FOR SUBMITTING POINT DATA AS ASCII FILES

- Point data must consist of two separate ASCII files as defined below:

File 1 will be the Data File. This data file will have:

- Spatial coordinates (X,Y) preferably expressed as Universal Transverse Mercator Coordinates in UTM Zone 12 (UTM Zone 11 in areas west of East Missoula). Other acceptable data coordinates are Latitude/Longitude expressed in decimal degrees, or State Plane Coordinates (SPC) with the SPC zone documented. If necessary, Anaconda Mineral Company Coordinates may be accepted. Point data located using the United States Public Land Survey System (township/range) are not acceptable.

- A field that contains a unique identification number for each point feature.

- A field that documents the locational accuracy of the point data must be included with the data. For example, an entry of 50 would indicate the point locations are accurate to ± 50 feet. This field will be named **ACCURACY** and will be defined as an **INTEGER** type with an **INPUT WIDTH** of 5 and an **OUTPUT WIDTH** of 5.

- The remaining fields in the Data File will be additional locational information or descriptions, and attribute data related to the point locations.

The ASCII Data File should contain one line of less than 80 characters for each data record. If it is not possible to fit the entire data record into a line of < 80 characters, then all fields must contain the same number of characters on each line. Every item or field in the file must be separated by some delimiter that does not appear within any of the fields, such as a pound sign (#) or bar (|). It is recommended that the bar (|) be used. Figure 1 shows two records from a database and what their ASCII records in the Data File would look like using the bar (|) as the delimiter.

File 2 will be a Data Definition File. This file will contain the name for each field in the Data File, its type (integer, binary, character, etc.), the input width of the field, the output width of the field.

Field Names and Definitions: You MUST define EVERY item that appears in the Data File, and these definitions MUST appear in the Data Definition File in the same order as the items

Figure 3 illustrates the way the ASCII Data Definition File would look.

Sample ASCII DATA DEFINITION FILE

```
Survey
7
7
C
Station
6
6
C
Latitude
10
10
C
Longitude
11
11
C
X-COORDINATE
4
10
F
1
Y-COORDINATE
4
10
F
1
Date
8
8
D
Depth
4
8
F
3
```

Figure 3: A sample Data Definition File.

Appendix G: GIS DATABASE DESIGN FOR NPL SITES AND OPERABLE UNITS

The top level of the database consists of the following disk partitions and upper level directories:

COMDEV: This disk partition contains files necessary for the operation and monitoring of the computer.

FORTRAN: This directory contains the source code and executable files for FORTRAN programs used by the GIS. For example, this directory contains the Anaconda to UTM coordinate program, registration TIC generation programs, and data re-formatting programs.

LOG_TIME: This directory contains the programs and files for the Log-Time cost accounting program.

OTHERS: Other directories are necessary for the operation of the computer but have no direct bearing on the database design for the project. These directories are: MAIL (Log-Time electronic mail directory); CMDNC0 (directory of user commands); MAIL.UFD (related to the Log-Time electronic mail function); and DOS, MASTER_INDEX, MFD, SYS (these are used by the Primos operating system).

ARC50: This disk partition contains files necessary for the operation of the ARC/INFO software.

MSLSYM: This directory contains symbols files for points, lines, and areas. These files, custom-designed at EMSL-LV and at the State Library, are referenced during Arcplot sessions and the creation of map compositions.

ARCEXE50: This directory contains all other files necessary for the operation of ARC/INFO.

MONTAN: This disk partition is work-space for non-Superfund system projects.

EPA: This directory is the work-space for non-Superfund EPA projects.

OTHERS: Other directories will be created as necessary for non-Superfund system projects.

SUPFUN: This disk partition is the work-space for the Clark Fork Superfund GIS data and projects. Within the SUPFUN partition are three sub-directories: **WORK, GIS-1, and GIS-2**. Within each of the upper level directories are lower-level directories representing the Superfund NPL sites and basin-wide map data. Under these directories are additional sub-directories for the individual data coverages and map compositions, documentation, and other necessary information.

WORK: This directory is the workspace which will contain all unverified Superfund coverages and all coverages which are in the process of being created.

GIS-1: This directory is the workspace for all coverages whose spatial coordinates (but not feature atttributes) have been verified.

GIS-2: This directory is the workspace for all coverages which have both spatial coordinates and feature attributes verified.

EMSL-LV: This directory is a workspace for EMSL-LV. For example it may be used when importing map coverages or a despository for various programs supplied by EMSL-LV.

Top Level GIS Directories

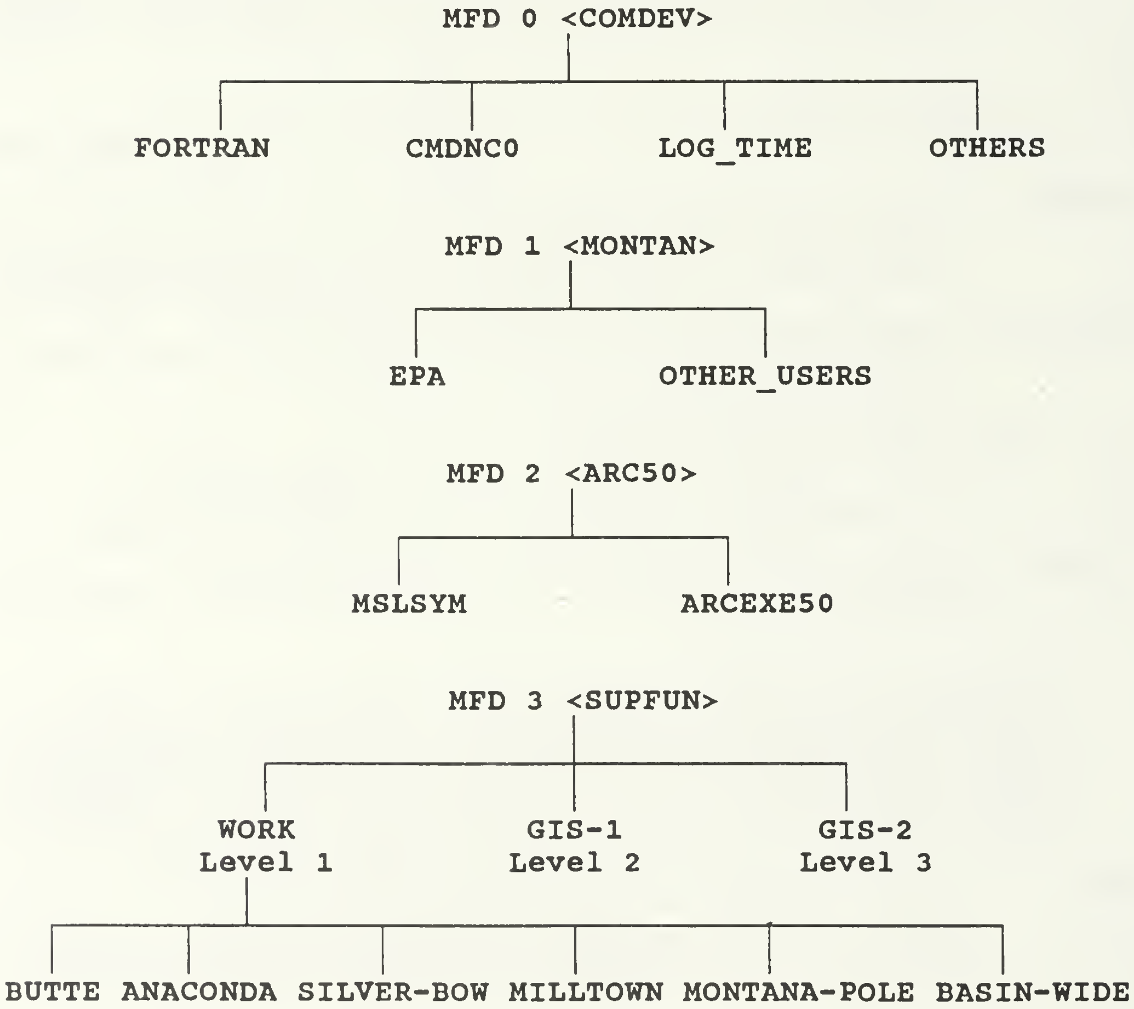


Table 1. DATA DICTIONARY FILE CATEGORIES

File	File Description
LAYER.DEF	Description of layers (map coverages). Includes: date, project title, location, pathname, theme, coverage definition and history.
SOURCE.DEF	Description of layer (map coverage) data sources. Includes: input date, scale, generation of data, method, source map projection, map type, map medium, pre-delivery data analysis, quality control, hardware and software specifications, and data source agency/company.
ITEM.DEF	Definition file of layer items. Includes: name, definition and history of an item assigned to a layer, minimum and maximum item values, and name of value definition file for the item.
LAYER/ITEM	Permanent relational file. Includes all combinations of layers with items found in the data set. Each item is assigned an item order within its layer.
Value Definition Files	INFO look-up tables for items whose values are expressed as codes. Includes: value codes and their definitions. Filenames are listed in the ITEM.DEF file.
Quality Assurance Files	Text files of quality assurance and control measures taken by the source agency/company providing the coverage data. Filenames are listed in the SOURCE.DEF file.
LOC.CODE	Description file of coverage location codes.
PROJEC.CODE	Description file of map projections codes.
METH.CODE	Description file of data input method codes.
MTYPE.CODE	Description file of map type codes used in source map data input.
MEDIA.CODE	Description file of source map media codes.
FEAT.CODE	Description file of coverage feature type codes.
A/C.CODE	Description file of agencies and companies responsible for the coverage data, as listed in the SOURCE.DEF file. Includes: reference codes, name, title and telephone number of contact person, agency/company name and address.
DICT.CODE	Glossary file of codes used to build definition and description files in the data dictionary.

Figure 1. **Data Dictionary File Relationships**

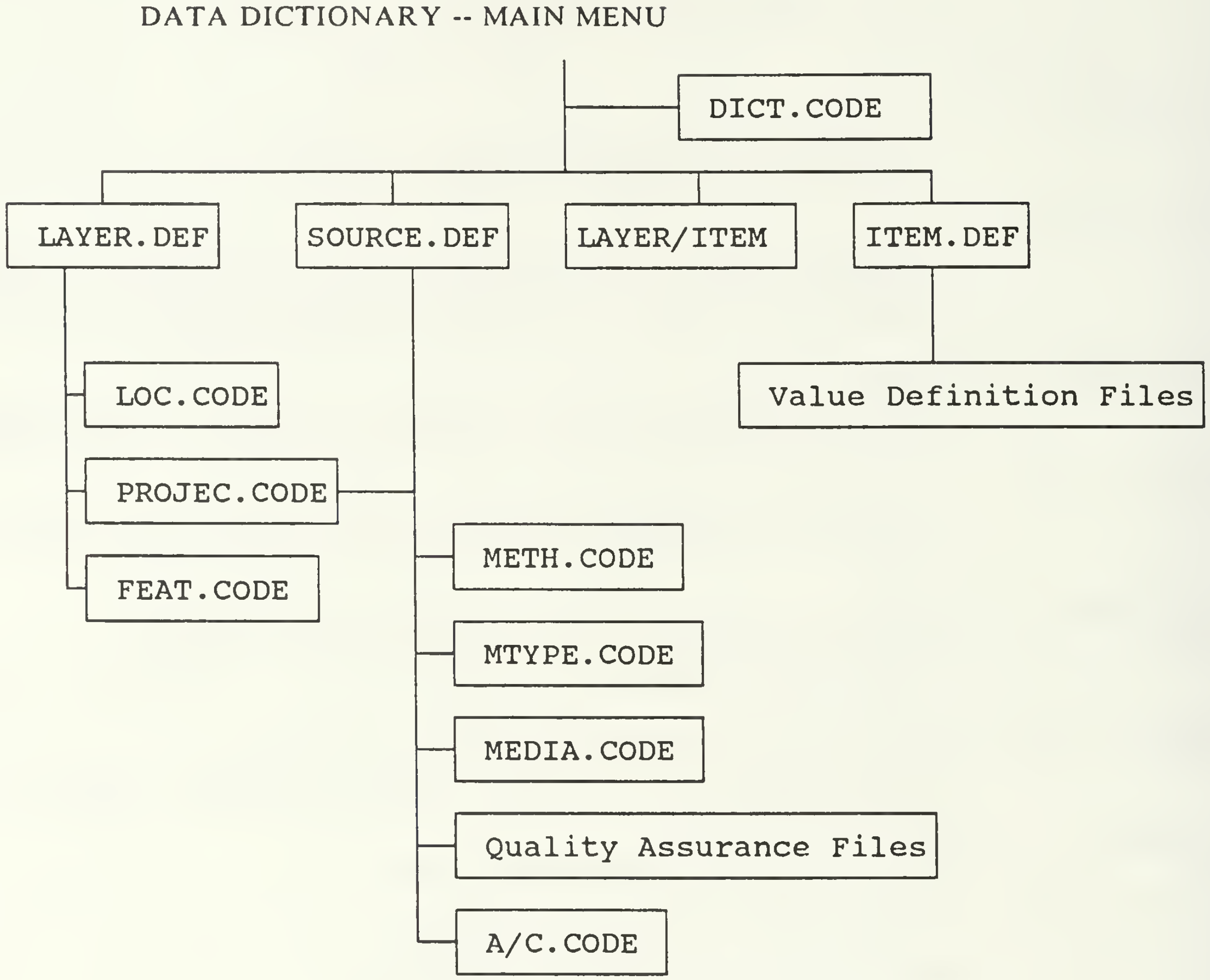


Table 2: **FAMILY OF FILES UNDER EACH DICTIONARY FILE CATEGORY**

FILE #	CATEGORY	RESTRICTED EDIT ACCESS	INPUT FORM	REPORT FORM
1.	LAYER.DEF	X	X	X
2.	SOURCE.DEF	X	X	X
3.	ITEM.DEF	X	X	X
4.	LAYER/ITEM	X	X	X
5.	Value Definitions	X		
6.	Quality Assurance	X		
7.	LOC.CODE	X		
8.	A/C.CODE	X	X	X
9.	FEAT.CODE	X		
10.	PROJEC.CODE	X		
11.	METH.CODE	X		
12.	MTYPE.CODE	X		
13.	MEDIA.CODE	X		
14.	DICT.CODE	X		

Table 3. COVERAGE NAMING CONVENTIONS USING SUBJECT CODES

Each coverage is assigned an alphanumeric code name. The first two characters are letter subject codes, and the two-digit number attached is a sequential number.

Coverage Subject Code:

AB - Administrative Boundary
CG - Census Groups
CB - Census Blocks
CT - Census Tracts
DU - Dumps
EL - Elevations
FP - Floodplain
FV - Fault/Veins
GE - Geology
HD - Hydrography
LU - Land Use
ML - Mill Sites
MS - Mine Shafts
MP - Montana Pole Sites
OP - Open Pit Mines
RR - Railroads
RD - Roads
SC - Schools
SO - Soils
SS - Soil Samples
SU - Survey
TO - Topography
VG - Vegetation
WS - Well Sites

Examples:

DU01 -- Dumps, 02; This is the second Dumps coverage.
RR15 -- Railroads, 15; This is the fifteenth Railroads coverage.

INPUT FORMS WITH DIRECTIONS, AND SAMPLE REPORTS

Files LAYER.DEF, SOURCE.DEF, LAYER/ITEM, ITEM.DEF, VALUE.DEF, AND A/C.CODE have input forms. All of these files have standard report formats for printing entire records. The following pages include each input form with the appropriate format for filling in each data field, directions for completing them, and example reports of the same datafile.

The input form is the same as the standard report form for the same file. This allows easy verification of the record contents as entered. Where codes are used to fill in the data fields, the corresponding reports include data decoded. Reference code files are provided to the data entry technician to look up codes for entries.

Standard reports have been created for files LAYER.DEF, SOURCE.DEF, LAYER/ITEM, ITEM.DEF, VALUE.DEF, QUAL.TEXT, and A/C.CODE. The reports display the complete record, as entered in the file. The contents ofthe remaining auxillary files may be reported using INFO commmand REPORT, until a menu-driven reporting program has been written for standard and custom dictionary reports.

LAYER.DEF INPUT FORM --DATA ENTRY INSTRUCTIONS

The following is a list of items whose values must be entered to complete a record defining the coverage. Each item prompt is followed by a value field of a set length of characters, or integers.

Data Field	Description	Example
Date	Date of record entry	02/20/89
Project Title	GIS project title	Clark Fork Superfund
Coverage Code	Code assigned to coverage	AB01
Pathname	Pathname of coverage file	<SUPERFUND>WORK>PRSOIL
Full Name	Name of coverage	PR-SOIL
Theme	Coverage theme	Toxic soils study
Location	Coverage location code	BU (Butte)
Map Feature Type	Coverage feature code	PO (polygon)
Current Map Projection	Map projection code	U12 (UTM Zone 12)
Storage Tape Label	Magnetic storage tape label	#20
Definition	Coverage defined	(see sample report)
History	Detailed coverage development and composition	(see sample report)

LAYER.DEF INPUT FORM

DATE (MO/DA/YR) 8D PROJECT TITLE: 35C

COVERAGE CODE: 4C PATHNAME: 50C

FULL NAME: 30C

THEME: 50C

LOCATION (CODE): 4C
MAP FEATURE TYPE (CODE): 2C
CURRENT MAP PROJECTION (CODE): 4C
STORAGE TAPE LABEL: 15C

DEFINITION:
80C
80C

HISTORY:
80C
80C

LAYER.DEF RECORD REPORT

DATE (MO/DA/YR) 02/20/1989 PROJECT TITLE: Clark Fork Superfund Project

COVERAGE CODE: AB01 PATHNAME: <ARCINF>SUPERFUND>WORK>BUTTE>PRSOIL

FULL NAME: PR-SOIL

THEME: Priority Soils for Toxic Cleanup

LOCATION: Butte
MAP FEATURE TYPE: Polygon
CURRENT MAP PROJECTION: UTM Zone 12
STORAGE TAPE LABEL: #20

DEFINITION:
Boundaries of (39) Phase 1 and (2) Phase 2 soils. Operable Unit in uptown Butte. Phase 1 = study of contamination of residential soils; Phase 2 = study of environmental concerns.

HISTORY:
CDM originally inked the boundaries on a mylar diazo copy of an Anaconda Co. map, which was used as the base map for digitizing by the MSL GIS project personnel.

SOURCE.DEF INPUT FORM -- DATA ENTRY INSTRUCTIONS

The following is a list of items whose values must be entered to complete a record defining the input of the source data entered in the creation of the coverage. Each item prompt is followed by a value field of a set length of characters, or integers.

Data Field	Description	Example
Coverage Code	Code assigned to coverage	AB01
Date	Date of coverage input	12/88
Scale	Source map scale as 1:	12000
Generation#	Data input generation	1
Derived (Y/N)	Input is derived from other data elements	N (No)
Method	Method of data input from source map (code)	D (digitized)
Projection	Source map projection (code)	U12 (UTM Zone 12)
Map Type	Type of source map	T (topographic)
Medium	Medium of the source map	M (mylar)
Pre-delivery Data Analysis	Prior data manipulation, or analysis	None
Quality Control	Reference text file on quality controls applied	QUAL.TEXT
Source Agency/Co.	Code assigned to source of the coverage data	SL01
Hardware Spec.	Hardware used to enter coverage data	Calcomp 9100 digitizer, Prime Minicomputer.
Software Spec.	Software used to enter coverage data	ARCEDIT

SOURCE.DEF INPUT FORM

COVERAGE CODE: 4C
SOURCE DATA INPUT:

DATE (MO/YR)	4C
SCALE 1:	9C
DATA GENERATION:	2C
DERIVED (Y/N)	1C
METHOD (CODE):	1C
MAP PROJECTION (CODE):	4C
MAP TYPE (CODE):	1C
SOURCE MAP MEDIA (CODE):	1C

PRE-DELIVERY DATA ANALYSIS:
80C

QUALITY CONTROL DESCRIPTION. TEXT FILENAME: 15C

SOURCE AGENCY/COMPANY CODE: 4C

HARDWARE SPECIFICATIONS:
80C

SOFTWARE SPECIFICATIONS:
80C

SOURCE.DEF RECORD REPORT

COVERAGE CODE: AB01
SOURCE DATA INPUT:

DATE (MO/YR)	12/88
SCALE 1:	12000
DATA GENERATION:	1
DERIVED (Y/N)	N
METHOD:	Digitizer
MAP PROJECTION:	State Plane
MAP TYPE:	Topographic
SOURCE MAP MEDIA:	Mylar

PRE-DELIVERY DATA ANALYSIS:
None

QUALITY CONTROL DESCRIPTION. TEXT FILENAME: QUAL.TEXT

SOURCE AGENCY/COMPANY:

NAME:	Montana State Library, Clark Fork GIS Project
CONTACT PERSON:	Allan B. Cox
JOB TITLE:	GIS Program Director
TELEPHONE:	(406) 444-5357

HARDWARE SPECIFICATIONS:
Calcomp 9100 Digitizer, Prime mini-computer

SOFTWARE SPECIFICATIONS:
ARCEDIT

ITEM.DEF INPUT FORM --DATA ENTRY INSTRUCTIONS

The following is a list of fields to define the INFO Items for each coverage. You will be prompted to fill in each data field of the record. The total number of characters available for the field entry is given on the first page of the input form.

Data Field	Description	Example
Item Code	Code used to relate INFO item to coverage definition file	PHAS
Item Name	Full name of the INFO Item	PHASE
Item Values Encoded?	The item values are a subset of codes?	Y (Yes)
Minimum Value	Minimum numerical item value	(NA)
Maximum Value	Maximum numerical item value	(NA)
Definition	Definition of the INFO Item	(see sample report)
History	Application of the Item within the coverage	(see sample report)

Example forms are attached showing the format of each data field entry, ie. characters (C), and the contents of several records.

ITEM.DEF INPUT FORM

ITEM CODE: 4C   ITEM NAME: 30C
ITEM VALUES ENCODED (Y/N) 1C

MINIMUM VALUE: 15N   MAXIMUM VALUE: 15N
DEFINITION:
80C
80C

HISTORY:
80C
80C

ITEM.DEF RECORD REPORT

ITEM CODE: SOID   ITEM NAME: PR-SOIL-ID
ITEM VALUES ENCODED (Y/N) N

MINIMUM VALUE: 0   MAXIMUM VALUE: 999999

DEFINITION:
Internal ARC/INFO identification number.
Identifies input order and connectivity of coverage polygons.

HISTORY:
Application of this ID number varies with each coverage.
ID is stored in an internal binary number format.

ITEM.DEF RECORD REPORT

ITEM CODE: PHAS   ITEM NAME: PHASE
ITEM VALUES ENCODED (Y/N) N

MINIMUM VALUE: 0   MAXIMUM VALUE: 999999

DEFINITION:
PHASE 1 & 2 soils have work plans for the study and cleanup of
residential soils & soils of general environmental concern.

HISTORY:
EPA is drafting PHASE 1 and PHASE 2 work plans in FEB/1989
PHASE number is stored in a binary number format.

LAYER/ITEM INPUT FORM -- DATA ENTRY INSTRUCTIONS

The following is a list of data fields to describe the relationship between each coverage and the INFO Items that make up that coverage.

Data	Description	Example
Coverage Code	Code assigned to coverage	AB01
Item Code	Code assigned to coverage Items	AREA
Item Order in Coverage	Ranking of Item in the Coverage	1

LAYER/ITEM INPUT FORM

COVERAGE CODE: 4C ITEM CODE: 4C ITEM ORDER IN COVERAGE: 21

LAYER/ITEM RECORD REPORT

COVERAGE CODE: AB01 ITEM CODE: AREA ITEM ORDER IN COVERAGE: 1

LAYER/ITEM RECORD REPORT

COVERAGE CODE: AB01 ITEM CODE: PERI ITEM ORDER IN COVERAGE: 2

LAYER/ITEM RECORD REPORT

COVERAGE CODE: AB01 ITEM CODE: SO# ITEM ORDER IN COVERAGE: 3

LAYER/ITEM RECORD REPORT

COVERAGE CODE: AB01 ITEM CODE: SOID ITEM ORDER IN COVERAGE: 4

LAYER/ITEM RECORD REPORT

COVERAGE CODE: AB01 ITEM CODE: PHAS ITEM ORDER IN COVERAGE: 5

A/C.CODE INPUT FORM -- DATA ENTRY INSTRUCTIONS

The following list of data fields describe the source agency, or company, for the coverage data.

Data Field	Description	Example
A/C Code	Code used to relate source agency/company to coverage definition file	SL01
Contact Person	Person responsible for communications regarding the coverage at the A/C	Allan B. Cox
Job Title	Job title of the contact person	GIS Project Dir. Agency/Company
Name	First and second names for the source data agency/company	Montana State Library, Clark Fork GIS Project
Address	Address of the agency/company for the source data	1515 E. 6th Ave. Helena, MT 59620
Telephone	Telephone number of the contact person	(406)444-5357

Example forms are attached showing the format of each data field entry, ie. characters (C), and the contents of one record.

A/C.CODE INPUT FORM

A/C.CODE: 4C CONTACT PERSON: 35C
JOB TITLE: 20C

AGENCY/COMPANY NAME: 35C
35C

ADDRESS: 75C
75C

TELEPHONE: 30C

A/C.CODE RECORD REPORT

A/C.CODE: SL01 CONTACT PERSON: ALLAN B. COX
JOB TITLE: GIS PROJECT DIRECTOR

AGENCY/COMPANY NAME: MONTANA STATE LIBRARY
CLARK FORK GIS PROECT

ADDRESS: 1515 EAST 6TH AVENUE
HELENA, MT 59620

TELEPHONE: (406)444-5357

Appendix I: SAMPLE PRINTOUT OF COVDOC.AML

```
                              Description of Coverage: PR-SOIL
Coverage Code: AB01
Summary:

Coverage Type: polygon                                  Manuscript Producer: CDM

Manuscript: 1:12,000 scale mylar

Manuscript Date: 5-1-84                                 Manuscript RMS error: .004326

Input Scale: 1:12,000                                   Average RMS error: .004457

Digitized by: Gerry Daumiller                           Date Produced: 12-6-88

Coverage Units: Meters

Coverage Projection: UTM zone 12

Projection Parameters: Yshift -5,000,000

***** DESCRIBE 02/21/89 *****************************************************************
                              Coverage Description for PR-SOIL

       ARCS                                             POLYGONS
Arcs             =      59                              Polygons    =      44
Maximum Node #=         55                              Polygon Topology is present.
Segments         =      829                             18 bytes of Attribute Data/polygon

       POINTS                                           SECONDARY FEATURES
Label Points  =        43                               Tics        =      88
                                                        Annotations =          0
                                                        Links       =          0

       TOLERANCES                                       STATUS
Fuzzy   =      0.7167844 N                              The coverage has not been edited
Dangle  =              0 N                              since the last BUILD or CLEAN.

                                 COVERAGE BOUNDARY
Xmin =       378842.9                                   Ymin =       91782.53
Xmax =        382674.1                                  Ymax =        98950.38

***** ITEMS 02/21/89 ********************************************************************

TYPE  NAME                 INTERNAL NAME   NO. RECS   LENGTH   EXTERNAL
DF      PR-SOIL.TIC           ARC048DAT        88          12          XX
DF      PR-SOIL.BND           ARC049DAT        01          16          XX
DF      PR-SOIL.PAT           ARC050DAT        44          18          XX

PR-SOIL.PAT
COLUMN         ITEM NAME  WIDTH        OUTPUT        TYPE  N.DEC
 1             AREA        4           12            F      3
 5             PERIMETER   4           12            F      3
 9             PR-SOIL#    4           5             B      -
 13            PR-SOIL-ID  4           5             B      -
 17            PHASE       2           4             B      -

***** LOG 02/21/89***********************************************************************
Date           Time  Connect      CPU   I/O   Command
12/6/88 12:05  0            3      1    create pstr04
12/6/88 12:10  1            9      2    TRANSFORM PSED03 PSTR04
12/6/88 14:21  0            6      2    COPY PSTR04 PR-SOIL
```

Appendix J: MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT

This Memorandum of Agreement ("Agreement") is entered into between the United States Environmental Protection Agency ("EPA") Region VIII and the Department of Health and Environmental Sciences of the State of Montana (the "State"). This Agreement establishes a procedure by which documents may be exchanged or viewed between EPA and the State in the context of remedial, enforcement, and natural resource damage actions pursued by the State or EPA under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA"), 42 U.S.C. § 9601 et seq. All references below to sections of CERCLA shall be deemed to include original language of CERCLA and, where applicable, the provisions of the Superfund Amendments and Reauthorization Act ("SARA") of 1986.

I. PURPOSES

The purposes of this Agreement are to:

1) Provide a mechanism for review and/or exchange of documents associated with remedial, enforcement, and natural resource damage actions pursued by EPA or the State under CERCLA, including actions undertaken by EPA or the State pursuant to cooperative agreements executed by the parties pursuant to section 104(d) of CERCLA, 42 U.S.C. § 9604(d).

2) Establish procedures for close cooperation and consultation between the parties in order to make optimal use of the parties' resources and to avoid possible conflicts and duplication of effort.

3) Provide for the review and/or exchange of technical information, reports, studies, or other pertinent materials regarding the sites in a manner that will ensure the protection of the confidential status of enforcement related and other privileged information.

II. SCOPE

This Agreement covers documents obtained or prepared in anticipation of CERCLA enforcement actions or hazardous substance cleanups at all existing and future sites in Montana which are subject to CERCLA.

III. EXCHANGE OF INFORMATION

Except when disclosure is prohibited by law or when necessary to protect a privilege in any ongoing or potential litigation, the parties agree, upon request, to exchange or make available for review in accordance with the procedures in paragraph 4 of this Agreement when applicable or through another mutually established method, all data, analyses, summaries, reports, studies, documents, or other pertinent information, materials, or evaluations received or prepared by the parties or their contractors or obtained from the potentially responsible parties for any of the sites referred to above. The parties shall promptly inform each other of the availability of such records. Consultation regarding the existence of documents may be established at regular intervals.

In the event that records are exchanged or reviewed which are privileged or exempt from mandatory disclosure under applicable Federal or State law, the parties agree that such records are being exchanged or reviewed to further: 1) the purposes of this Agreement; 2) the enforcement objectives set out under CERCLA and this Agreement; and 3) the common interest of the parties in the protection of the public health, welfare, and protection of the environment or recoupment for loss of natural resources at existing or future CERCLA sites. The parties will take all steps necessary to ensure that such information is kept confidential consistent with 40 C.F.R. Part 2 and other applicable State and Federal requirements, including those set forth in paragraph 4 of this Agreement. Both parties agree to protect each other's claims for confidentiality and exemptions to public release requirements of such exchanged information, particularly with regard to records related to potential or ongoing enforcement actions. By entering into this Agreement, neither party intends to waive any privileges or claims for exemptions from record release requirements which it may assert against third parties.

The State and/or EPA will consult prior to the release of any records generated by the other party to a third party and will not release such records without the other party's consent, except as required by law. The relevant State project officer or his designee shall be primarily responsible for ensuring these consultations occur with the relevant EPA project officer or his designee.

Within sixty (60) days of the effective date of this Agreement, EPA shall provide a training course for State and EPA personnel concerning implementation of this Agreement. This training course shall have as its objectives:

a. Training of State and EPA personnel in categorizing enforcement-related information under the procedures in this Agreement.

b. Training of State and EPA personnel in procedures for handling confidential information.

c. Training of State and EPA personnel and contractors in preparation of documents in a manner that minimizes the amount of enforcement confidential information in documents.

IV. CLASSIFICATION OF INFORMATION

All documents prepared by EPA and State staff or contractors which are deemed useful to the State in carrying out the State's responsibilities under cooperative agreements shall be reviewed by EPA and State project officers prior to exchange between the parties in order to evaluate the degree of enforcement sensitivity of each document and for characterization into one of three categories. The project officers shall consult their respective legal counsels in evaluating the degree of enforcement sensitivity. When a document has been assigned to a category, the State and EPA shall follow the procedures set forth below for that category.

Category One

This category includes enforcement confidential, internal legal, strategy, and pre-decisional documents. Examples include draft and final PRP reports, enforcement strategies, settlement analyses, legal opinions, certain pre-decisional documents or memoranda, and attorney-client communications and attorney work products which EPA deems appropriate to allow the State to examine. These documents shall be made available at the EPA Montana Office for perusal by State Department of Health and Environmental Sciences staff. Such documents in this category may not be copied, memorialized in writing, or removed from the EPA Montana Office by State employees.

Category Two

a. This category includes enforcement confidential documents that must be made available to the State to facilitate State administration of State-lead cooperative agreement technical responsibilities. Examples are EPA technical comments on draft State workplans, Remedial Investigation reports and Feasibility Study reports and, when appropriate, draft EPA technical documents from other sites.

Such documents, while "enforcement confidential" and either privileged or otherwise subject to discretionary withholding by EPA under the Freedom of Information Act, may be provided to the State under certain restrictions specified on a case-by-case basis. Prior to obtaining documents in this category, the State must assure that such restrictions will be followed. The State shall return all such records to EPA within 2 weeks of receipt and shall not copy the documents unless otherwise agreed. The State and its contractors shall maintain such documents in a secure, locked file when not in use.

b. The State shall undertake whatever steps that may be necessary to maintain the confidential status of documents identified below originating within the State which were prepared for the purpose of complying with cooperative agreements under section 104(c)(3) of CERCLA or ensuring an appropriate response action of a potentially responsible party under sections 104, 106, or 107 of CERCLA.

These documents include draft technical memoranda, draft Remedial Investigation reports, draft public health evaluations, draft Feasibility Study reports, draft endangerment assessments, draft Records of Decision/Enforcement Decision Documents, briefing papers, and correspondence between legal staffs, as well as documents determined to fall into this category by EPA on a case-by-case basis.

The State project officer shall consult with the EPA project officer prior to releasing such documents to third parties. EPA and State legal counsel shall also be consulted. Unless otherwise agreed by EPA, the State shall deny requests for such documents by third parties.

The State shall maintain such documents in a secure, locked file when not in use.

Category Three

This category of documents, containing "general information" or non-sensitive enforcement-related information originated by EPA, may be determined by EPA and State counsel to be openly available to the State and the public on the basis that the information is disclosable under the Federal Freedom of Information Act ("FOIA").

V. MODIFICATION OF AGREEMENT

In the event of any change in the law or regulations upon which the terms and conditions of this Agreement are based, or any other circumstances necessitating a modification to this Agreement, and if approved by both parties, the parties may make such written modifications as are appropriate.

VI. LIABILITY

Nothing contained in this Agreement shall be construed to create, either expressly or by implication, the relationship of agency between EPA and the State. And standards, procedures, or protocols prescribed in this Agreement to be followed by the State during the performance of its obligations under this Agreement do not constitute a right of the EPA to control the actions of the State. EPA (including its employees and contractors) is not authorized to represent or act on behalf of the State in any matter related to the subject matter of this Agreement. Neither EPA nor the State shall be liable for the contracts, acts, errors, or omissions, or the agents, employees, or contractors of the other party entered into, committed, or performed with respect to or in the performance of this Agreement.

This Agreement shall not in any way release any persons or entities from liability with respect to the sites nor affect recovery of costs against such persons or entities.

The effective date of this Agreement is: 26 January 1987

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

By: ______________________
John J. Drynan, M.D., Director

ENVIRONMENTAL PROTECTION AGENCY
REGION VIII

By: Alexandra B. Smith
John G. Welles for
Regional Administrator

Appendix K: GIS USER SURVEY

DRAFT

Clark Fork
Geographic Information System
User Survey

September 1988

Compiled by

The GIS Project of the
National Resource Information System
Montana State Library
1515 East 6th Avenue
Helena, Montana 59620

DRAFT

Clark Fork Geographic Information System
User Survey Report

INTRODUCTION

This document summarizes the results of a survey of the Clark Fork Geographic Information System (CFGIS) users among the staff of the Montana Department of Health and Environmental Sciences and the Montana Office of the U.S. Environmental Protection Agency who are involved in the remedial investigations and feasibility studies (RI/FS) of the Upper Clark Fork River Basin in Montana.

The CFGIS was established in the fall of 1987 as a program of the Montana Natural Resource Information System (NRIS) of the Montana State Library (MSL). The CFGIS project operates under an Interagency Service Agreement between the MSL the Montana Department of Health and Environmental Sciences (MDHES) for the purpose of providing support services to MDHES pertaining to their responsibilities in the Superfund Program, including but not limited to sites at Silver Bow Creek, Montana Pole, Anaconda Smelter, and Milltown Reservoir. These four Superfund sites are located within a small area at the headwaters of the Clark Fork River. The close proximity of these sites, together with the large amount of data available for this general area, has necessitated the use of a Geographic Information System for cost-effective information management. This technology is being used successfully at other Superfund sites, although the Clark Fork River project area is unique in that the opportunity exists to develop a single GIS data base covering four separate Superfund sites. Under the interagency agreement, the CFGIS is responsible for:

1) Technical Assistance

2) Geographic Information System Management

3) Interagency Coordination

CFGIS PROJECT STATUS

To better understand the results of the User Survey, it will help to have a picture of the current status of the system.

- A GIS officer and a GIS technician have been hired.

- The initial equipment (Prime minicomputer, printer, plotter, and 2 graphics terminals) and software (Primos, Arc/Info, & ERDAS) been identified, acquired, installed, and tested.

- Training in the operation of the GIS is underway. Training was initially provided to twelve prospective GIS users among EPA, MDHES, and MSL staff directly connected with the Clark Fork Superfund sites. Additional in-depth training is being provided to the GIS Officer and GIS Technician to ensure the ability to utilize the system to its fullest extent.

- The creation of the initial data set is underway at Environmental Monitoring Systems Laboratory, Las Vegas. Products will be loaded, evaluated for completeness and accuracy, and added to the data base as they are made available.

- A GIS Resource Document has been prepared. The document contains general information relevant to GIS, as well as information specific to the Clark Fork GIS, including:

    - data base status and projections
    - system capabilities
    - access and use information
    - GIS educational resource material

- An initial inventory of existing data sets and remote sensing information pertinent to the Clark Fork system sites has been prepared.

- A CFGIS task force was formed and has met to provide direction relative to data acquisition, pilot projects, and long term planning. To assist the task force, this user survey was conducted to identify necessary products as well as to determine the appropriate level of involvement of the various EPA RPMs and State Project Officers. The results of the User Survey will form the basis for a formal project plan.

- The system is operational and is responding to user requests for special purpose mapping. Initial work is being performed on a pilot project identified by the CFGIS task force which involves the Anaconda Smelter Site.

SURVEY PURPOSE

The purposes of the CFGIS User Survey were as follows:

- To have prospective GIS users identify the NPL sites and the associated operable units to which the users planned to apply GIS techniques;

- To identify existing and planned data and their formats;

- To identify required GIS capabilities and anticipated general and specific data analysis needs;

- To identify user output needs;

- To identify the ways the users anticipate interacting with the system

- To identify the specific goals and objectives the users hope to achieve by using GIS techniques; and,

- To generate a summary document to help guide future system design, implementation, and project plan formulation.

SURVEY ADMINISTRATION

To assess the Clark Fork GIS user expectations and needs, a survey instrument (see Appendix A), was designed that addressed the following issues:

1) identification of NPL sites and operable units to which GIS techniques could be applied;

2) identification of current and anticipated data;

3) identification of general and specific data analysis needs;

4) identification of GIS output product needs;

5) anticipated GIS user interfaces; and,

6) specific goals and objectives for using the GIS.

The survey was developed by the CFGIS staff at the Montana State Library and was reviewed by personnel at the Montana Department of Health and Environmental Sciences and the Montana Office of the Environmental Protection Agency.

The survey was administered to both state and federal NPL site officers at the MDHES and EPA. Follow-up interviews were conducted by the CFGIS staff with nine survey respondents. The follow-up interviews were also used as an opportunity to answer questions about GIS applications and principles from the site officers as well as to provide demonstrations and explanations of system capabilities.

SURVEY RESULTS

The survey results are summarized below. The actual results are reported in Appendix B. Where deemed appropriate, specific recommendations are made based on the survey results.

NPL Sites and Operable Units

MDHES and EPA site officers were asked to identify the NPL sites with which they worked. All four of the Superfund sites in the Clark Fork Basin--Silver Bow Creek (including the Butte addition), Milltown Dam, Montana Pole, and Anaconda Smelter--were represented in the survey and all respondents identified site specific GIS applications.

MDHES and EPA site officers were also asked to identify the operable units with which they worked to which they felt they would apply GIS techniques. A variety of operable units were identified, but the principle ones dealt with issues related to soil contamination, surface and groundwater contamination, sediments, and cost recovery.

Two site officers mentioned a desire to apply GIS techniques to two non-Clark Fork River Superfund sites -- East Helena and Somers-- which are at early stages of investigation and could be geared to make use of GIS from the beginning.

With four NPL sites, multiple operable units, and a large number of potential GIS applications, the acquisition of an accounting software package on the CFGIS computer to track the use of the system is clearly needed.

Data Needs

Much of the current data used by site officers are not in digital form and would require additional work to enter into the CFGIS. An exception is the Anaconda Smelter site which was the pilot for the development of the Clark Fork Data Management System (CFDMS)--a common database management system for the four Superfund sites in the Upper Clark Fork River--of which the CFGIS is one component. Site officers are making an effort to insure that data collected under new work orders are compiled and output in digital form to facilitate input into the CFDMS and CFGIS.

The principle map data identified as needed were high quality topographic maps with base information for hydrography and transportation. Several site officers stated in the interviews that they were using rather poor quality maps and could use more detailed and accurate maps for their sites. Currently there are contracts to produce more detailed topographic maps for the Butte Addition (1:2400), Anaconda Smelter, and Montana Pole (1:2400). *

A complete listing of the existing and anticipated data identified in the survey is contained in Appendix B: Results.

Several recommendations are made based on the survey results and interviews:

1) The data system staff at both MDHES and MSL should continue and increase play a more active role in working with site officers in developing work orders for contractors and PRPs in regards to data collection and compilation efforts. The increased involvement will help ensure the compatibility and ease of input of future data acquisition.

2) The data system staff should continue their efforts to develop and refine procedures for data conversion from the CFDMS as well as from other database systems to GIS format.

3) EMSL-LV should continue their efforts to develop and refine a computer program to convert Anaconda Mineral Coordinates to UTM coordinates, and provide future assistance as needed in resolving data conversion problems.

4) The CFGIS staff should continue to identify and inventory existing applicable data and data sources.

5) Development and implementation of a data administration program to guide QA/QC procedures should be a high priority of the Clark Fork GIS Technical Working Group. This development should be coordinated with data administration procedures being developed by the site officers.

Data Analysis Needs

A. General GIS Needs

The site officers were asked to indicate the general ways they anticipated using the CFGIS. All but one of the respondents indicated a desire to use the system, particularly to perform spatial analyses.

There was a strong need expressed in the survey results for statistical analysis in addition to spatial analysis--indicating the need for the CFGIS project to move forward in obtaining access to statistical application programs (e.g., forming a link to the state main frame computer and using SAS or purchasing a statistical package for the Prime).

There was enough of a response (about half) to indicate that users wish to employ the system for regular queries of the database. This response implies the need to develop easy to use, customized AML programs to allow easy access and querying of the data base and access to graphics terminals.

Additional comments on the survey forms as well as in the interviews identified the desire to utilize special models or programs: Kriging programs to interpolate point data; ground and surface water models to generate data for inclusion in the CFGIS. Efforts should be made to identify applicable programs and procedures should be developed for gaining access to these programs (whether through contract or purchase).

B. Specific GIS Needs

Prior to the formal needs assessment survey, input was solicited from the state and federal site officers concerning their GIS applications needs. In addition, the site officers were asked in the User Survey to re-state these potential GIS applications and to supply additional information. Included below is a summary of these responses.

1) Delineation of areas meeting specified levels for contaminants of concern which are also areas of a given population density or land use type; calculation of volume of contaminated material; calculation of removal costs; identification of hauling routes/distances to disposal sites and calculation of hauling costs; calculation of costs associated with replacement of volume removed. Using standard

exposure assumptions, calculate risk ranges for areas within communities. Monitoring of remedial process through updating database as work progresses.

Quickly and accurately re-analyzing and re-calculating costs/responsibilities/volumes/routes resulting from changes in alternatives being considered in feasibility studies; ability to answer "What if..." questions proposed by managers.

2) Identification of PRP's; calculation of and assignment of costs for recovery purposes.

Support the PRP identification process by automating a portion of the current process. Consistently apply rationale for allocating PRP responsibilities (NBARS - Non-binding Preliminary Allocation of Resources). Easily analyze how changes in variables affect costs and PRP responsibilities.

3) Analysis of pond re-contouring (cut and fill analysis) to facilitate runoff from tailings pond areas where infiltrating excess moisture may cause leachate problems to groundwater/surface water systems.

Ability to project effects of several possible solutions on downstream areas. Ability to analyze costs of various drainage networks to maximize runoff and minimize infiltration. Graphically display results of possible solutions.

4) Screening studies - Identification of potential sources and likely areas of deposition of contaminants.

Ability to concentrate future studies in the areas of likely contamination; ability to form or support hypotheses concerning contamination sources and pathways; identification and control of instances where attempts to clean up one area may contaminate other areas.

5) Identification of erosion pathways; establishment of surface drainage controls.

Use GIS modeling capabilities to calculate optimum slope of drainages.

6) Preparation of documentation for legal use; public information.

Use GIS formatting and map drawing abilities to prepare documents and supporting visuals for presentation to managers, to the public, and in court. Facilitate communication with non-technical and legal persons.

7) Water quality and fish trends - Use GIS analysis and display capabilities to show water quality and fish trends over time.

Assess results of natural events and proposed remedial activities; gauge the effectiveness of removal actions over time.

8) Determination of flood flow and sediment yield from varying precipitation events.

Facilitates the assessment of runoff sediment volumes and necessary diversion networks and settling pond capacities.

9) Development of contaminant distributions resulting from 100 years of stack emissions from the Anaconda Smelter.

Use GIS modeling and interpretation capabilities to identify likely areas of contamination; concentrate field studies.

10) Groundwater modeling and definition of subsurface characteristics; model contaminant flow system.

11) Operable unit definition; cost distribution among operable units.

Allows monitoring and rapid updating as operable unit definitions change and are refined; allows easy recalculation as variables (e.g. costs or areal extent) change.

12) Butte mine flooding - Depict mine flood situation over broad geographic area.

Ability of RPM's and consultants to quickly depict and analyze several scenarios for mine flooding based on hydrologic model variables.

13) Facilitate the rapid response to removal actions.

The data base developed to respond to GIS needs at the currently identified Superfund sites provides a substantial basis for addressing other problems which develop in the region. The GIS provides a method for OSCs to easily modify site design plans and evaluate the resultant impacts on the project.

In addition to identifying potential GIS applications, the respondents were asked in the User Survey to further define the application in terms of:

- Will the applications need to be repeated ?
- Is it a long-term project ?
- The approximate date when final GIS products/results would be needed.
- Would the GIS application automate an existing procedure ?
- Can this application be tracked as a separate operable unit or site-wide cost element?

These questions are helpful in determining if certain applications are suitable for GIS techniques. Determining the suitability of an application is critical because of the large up-front investment of time and money required to input the necessary data. GIS projects should be those that are long-term, where analyses need to be repeated, and when there is sufficient lead time to develop the required database.

The responses to the survey indicated that most of the identified applications involve procedures that need to be repeated, involve long-term work, and can be tracked as operable units or site-wide cost elements. In terms of automating an existing procedure, the applications were split: 60% were labelled as automating an existing procedure (either something already being done or as specified in investigation guidelines). The responses to this portion of the survey indicated that most of the applications would be appropriate to GIS techniques. Much of the information provided in the "Specific GIS Needs" section will aid in establishing priorities for the proposed GIS projects.

Procedures need to be developed to handle requests for GIS products and services. This issue needs to be resolved cooperatively among EPA, MDHES, and MSL. Questions to be addressed are: Who decides what projects are to be undertaken? Who sets priorities on projects? Who conducts data entry, verification, analysis? How are conflicts in system scheduling to be resolved? It is recommended that the Technical Working Group develop recommendations for these procedures.

Based on the applications identified above, it is evident that the Arc/Info software will need to be expanded to include the Triangulated Irregular Network (TIN) module. The TIN module is necessary for handling any Z-value data (volumetric or surface) data for the NPL sites.

Product Needs

In terms of the types of products required or anticipated, maps clearly led over tabular products. The site officers listed a variety of purposes for which they required map products:

- inclusion in written reports,
- public presentations,
* litigation, - crucial issue
- display of raw data,
- error checking,
- display analysis results (e.g., contaminant distribution, results of modeling, impacts of proposed FS alternatives), and,
- assist in identifying areas for new data collection efforts.

The stated purposes for tabular reports were similar to the above reasons for map products: inclusion in reports, negotiation and litigation efforts, public presentations, data summaries, data evaluations, and analysis results.

The current 8-pen CalComp plotter will supply many of the required maps. However, it is also recommended that a color ink-jet or thermal printer be acquired for producing maps for reports and overheads for public presentations. This type of printer will also provide fast "screen dumps" of maps and other graphics material for draft purposes prior to submitting jobs to the plotter.

Use of GIS

The survey clearly showed that the site officers do not wish to take the lead on GIS projects (only two responses indicated that desire) but that they are willing to be involved as needed if someone else takes the lead.

Also indicated by the survey was that five site officers wished to be hands-on users of the system. However, four of these five respondents qualified their answer on the survey and in the follow-up interviews with such comments as: while they would like to become hands-on users they did not have the time to learn the system; they did not have the time to use the system; would need easy-to-use macros to help them; and would still need assistance from the CFGIS staff. These responses regarding system use greatly reduce the immediate need to purchase multiple graphics terminals or terminal emulation software but indicates a greater need for Clark Fork data system staff to work closely with the site officers in developing and implementing GIS applications.

The survey--in both the written responses as well as the follow-up interviews--revealed a desire on the part of the site officers to use the GIS but also revealed the realistic lack of time they have to learn how to use the system or to actually use it. Many site officers interviewed expressed a desire to undergo GIS training (both Arc/Info specific as well as related to general concepts), but again indicated the lack of time to do so.

The response to this part of the survey--how the site officers anticipate using the system--has greater implications than affecting the number of graphics terminals or PCs to be installed. It affects all aspects of system implementation and operation and is a crucial factor in future system success. It is believed that the process of turning site officers into regular user will require an active role on the part of Clark Fork data system staff. The method proposed to facilitate that evolution is to make the system readily available to the site officers to help them become accustomed to GIS capabilities and benefits. Some recommended options for increasing access and use of the CFGIS are:

1) Place a workstation (with internal 327mb disk) or a graphics terminal (with the purchase of 2 496mb hard disks for the Prime) at EPA and at MDHES to be available for database queries and processing requests;

2) Link into the system the PCs of those site officers who expressed the desire to be on-line;

3) Develop user and application specific AMLs for site officers to use in making database queries performing analyses;

4) Designate one site officer at both EPA and MDHES as "GIS Liaison" to direct access to and provide assistance to other site officers in the office;

5) Continue to involve the Clark Fork GIS and DMS staff in meetings with site officers and contractors to assist in work plan development; and,

6) Continue to increase the presence of the Clark Fork GIS and DMS staff in the EPA and MDHES offices--that is, schedule regular time that the staff are present in the EPA and MDHES offices to assist in GIS requests and questions.

The crucial element in these options is increasing the active role and accessibility of the CFGIS and DMS staff to both the state and federal site officers.

GIS Objectives

Finally, the respondents were asked to identify the specific objectives/goals they hope to achieve by using the Clark Fork GIS. These objectives illustrate a wide variety of expectations and potential use and support of the system. The objectives ranged from specific application results to very general desires. The common objectives appear to be the following:

1) the desire to better define the nature and extent of the contaminants at the sites;

2) identification and assistance in planning future data collection efforts;

3) help in managing and accessing site data; and,

4) evaluation of potential remedial actions.

The actual responses are summarized below.

- ...the easy and ready accessibility of data in a geographical perspective

- Delineate areas of contamination

- Identify areas where more data are needed

- Better identify areas of contamination to aid in developing action alternatives for the Feasibility Studies

- Provide an understanding of the groundwater and surface water relationships between Silver Bow Creek and the Butte Addition

- Develop maps during the RI data collection to provide a better understanding of areal extent and trends in contamination, so that additional data collection can be efficiently designed

- Determine waste volumes for possible removal alternatives and assess costs associated with removal actions

- Possibly track PRP information

- Make use of existing data in system

- Speed up manipulation of data

- Facilitate and expedite the compilation and presentation of site data.

- Use to identify data needs.

- Use data to help solve designated problems through modeling, statistics, etc.

- Make planning exercises easier and more expeditious.

- Support conclusions in a demonstrative fashion.

- Communicate project findings and conclusions with PRPs, management and the public.

- Gain a better perspective of hazardous substances at site.

- Envision what the completely remedied site will look like.

- Assist in presenting actual conditions and understanding proposed remedial actions.

CONCLUSION

There are plenty of identified and potential GIS applications for the Clark Fork Superfund sites. To the contrary, there have been so many uses identified there need to be procedures developed to insure the multitude of requests can be handled effectively and in some priority order..

The User Survey demonstrates several important conclusions:

1) There are a wide variety of appropriate GIS applications in the Clark Fork River Basin Superfund sites.

2) Site officers at both state and federal level have a desire to make use of GIS data management and analysis techniques.

3) Site officers at both state and federal level do not have the time to become trained or be "hands-on" users of the system but would like to make system requests.

4) Little digital data exists but there are data collection efforts being planned which will generate digital products.

5) Creating a GIS that has value for the site officers and others involved in the remedial work on the Clark Fork River will require an active and leading role on the part of the Clark Fork GIS and DMS staff.

Simply making the resources available will not insure the system will be used. The site officers are caught in a dilemma because of the demands placed upon their time: a GIS has the potential to assist them in their work and help them make better use of their time, but the officers do not have the time to invest up-front in learning how to use GIS and complain of not having the time to use the system even if they were trained. However, nearly all site officers acknowledged the potential value of using the system and had no difficulty in identifying valuable applications of the system.

Appendix A

Clark Fork Geographic Information System Needs Survey
July 1988

Name: ____________________

Organization: ____________________

Specific Mailing Address:

____

____

____

____

Phone: ____________

NPL site(s) you work with: ____________________

Operable Units: ____________________

(Requiring GIS) ____________________

____

____

____

We request the opportunity to conduct a follow-up interview with you concerning your GIS needs. Please indicate two acceptable times when you can meet for one hour prior to July 26, 1988.

Time 1: ______________

Time 2: ______________

Please return this questionnaire by July 19, 1988 to:

Allan Cox
Montana State Library
Clark Fork GIS Project
1515 E. 6th Ave.
Helena, MT 59620

444-5357

I. Data Needs

What type of geographic-related data do you currently use ?

____

____

____

____

____

____

What format are these data:

__ Digital (tapes or diskette) ____________

__ Maps

__ Tabular

__ Other (explain) ______________________________

____

____

What type of geographic-related data do you anticipate using?

____

____

____

____

____

____

____

In what form will you receive these data:

__ Digital (tapes or diskette) ____________

__ Maps

__ Tabular

__ Other (explain) ______________________________

____

____

II. Data Analysis Needs

A. General GIS Needs

Please indicate the general ways you anticipate using the GIS. Check all appropriate responses.

__ Regular Queries (e.g., Where is a creek, how long is it, what is its name, where does it enter the Clark Fork, etc.)

__ Spatial Analysis (e.g., Determine the volume of contaminated soil at Smelter Hill; estimate removal or other treatment costs; identify appropriate disposal sites; evaluate various travel routes for haulage; or identify appropriate areas for re-vegetation along the Clark Fork, etc.)

__ Statistical Analysis (e.g., What is the mean age of the population of Walkerville, what is the population and population density along Silver Bow Creek within the Butte city limits, test the statistical likelihood of a particular contaminant level occurring at a particular location, etc.)

__ Other ______________________________

B. Specific GIS Needs

** Please photocopy this page for each additional project.

Provide a short (1 sentence) problem definition for each GIS analysis you anticipate. Please feel free to quote from the response you previously supplied regarding GIS projects:

Will this analysis need to be repeated ? __ Yes __ No

Is this a long-term project ? __ Yes __ No

If yes, how long ________________

Please identify an approximate date when final products/results are needed:

____

would this project automate an existing procedure ? __ Yes __ No

Can this project be tracked as a separate operable unit or site-wide cost element? __ Yes __ No

Additional Comments:

III. Product Needs

What type of GIS products do you anticipate needing:

__ Maps

For what purpose ?

____

__ Tabular Reports

For what purpose ?

____

__ Other (explain) ______________________________

____

____

For what purpose ?

____

Additional Comments:

____

____

____

____

____

____

IV. Use of GIS

Identify the way(s) you anticipate using or would like to use the Clark Fork GIS. Please check all applicable responses.

- __ Make requests, but have little or no involvement in the process.
- __ Make requests and be involved as needed.
- __ Make requests and take lead on project.
- __ Become a hands on user by (please check all that apply):
  - __ Using the system at the State Library;
  - __ Using the system from your office via a (_) graphics terminal and/or (_) P.C. with terminal emulation.

Additional Comments:

Describe the specific objectives/goals you hope to achieve by using the Clark Fork GIS:

Further suggestions or comments:

Appendix B

Clark Fork Geographic Information System Needs Survey

RESULTS

Respondents

MDHES	EPA
Phillip Hertzog	Russ Forba
Kevin Kirley	Charles Coleman
Doug Rogness	Ken Wallace
James Hill	Sara Weinstock
Kathy DeMarinis	Mike Bishop

NPL Sites and Operable Units Identified:

- Milltown Dam
    - Reservoir Sediments
    - Downstream Screening Study
    - Cost Recovery

- Montana Pole
    - Groundwater
    - Soils
    - Surface Water/Sediments

- Silver Bow Creek
    - Areal
    - Streamside Tailings
    - Rocker
    - Agricultural Lands
    - Clark Fork River

- Butte Addition
    - Priority Soils
    - Non-Priority Soils

- Anaconda Smelter
    - Site Wide Soils
    - Community Soils
    - Site Wide Groundwater
    - Surface Water and Sediment
    - Old Works
    - Flue Dust
    - Smelter Hill

I. Data Needs

(D indicates digital data, M indicates maps, and T indicates tabular data.)

Silver Bow Creek

Current Data

- 1:2400 scale maps of Silver Bow Creek Floodplain. (M)
- 1:6000 scale maps of the 100 year floodplain. (M)
- Maps prepared by Multi Tech during phase I Remedial Investigation. (M)

Anticipated Data

- Maps which show location and type of fluvially deposited tailings. (D,M)
- Maps showing location of impacts and relative contribution of non-point sources on water quality in Silver Bow Creek. (D,M,T)

Silver Bow Creek, Butte Addition

Current Data

- 1:2400 scale revised Anaconda Mineral Company maps. (M)
- Census Bureau data (D,M,T)
- Historical Sampling data (D,M,T)
- Priority Soils map (M)
- CDM dBase III data (D)
- Soil Screening Study (T)

Anticipated Data:

- 1:2400 scale ARCO maps with 5 foot contour interval. (M)
- Butte Soil Screening Study (D,M)
- Mine Flooding RI/FS
- Health RI/FS of Priority Soils

Anaconda Smelter

Current Data

- Clark Fork Data Management System (D,M,T)
- Aerial photos (M)
- Crude base maps (M)
- Heavy metal concentrations keyed to specific locations (D,T)

Anticipated Data

- Soil contaminant level profiles (D,M,T)
- Waste contaminant concentrations (D,M,T)
- Surface and ground water contaminant levels (D,M,T)
- Vegetative response (D,M,T)
- Maps of topographic, demographic, and modeling data for reports and presentations (M)

Milltown Dam

Current Data:

- Geologic maps (M)
- Sample data on surface and ground water quality, soil and sediment contaminant levels (T)
- Topography (M)

Anticipated Data:

- CDM downstream screening study (D,T)
- Maps correlating sample locations with topography for prediction of migration (D,M)

Montana Pole

Current Data:

- Topography (M)
- EPA site maps showing buildings, monitoring wells, groundwater systems, facilities (M)
- Soils data from monitoring wells (T)

Anticipated Data:

- Surveyed well locations (M,D)

II. Data Analysis Needs

A. General GIS Needs

Query Type*	# Responses
Regular Queries	6
Spatial Analysis	9
Statistical Analysis	7
Other	3

* Query Type Explanations:

Regular Queries (e.g., Where is a creek, how long is it, what is its name, where does it enter the Clark Fork, etc.)

Spatial Analysis (e.g., Determine the volume of contaminated soil at Smelter Hill; estimate removal or other treatment costs; identify appropriate disposal sites; evaluate various travel routes for haulage; or identify appropriate areas for re-vegetation along the Clark Fork, etc.)

Statistical Analysis (e.g., What is the mean age of the population of Walkerville, what is the population and population density along Silver Bow Creek within the Butte city limits, test the statistical likelihood of a particular contaminant level occurring at a particular location, etc.)

III. Product Needs

In response to the question "What type of GIS products do you anticipate needing", the following responses were received:

Product	# Responses	Purpose
Maps	4	Presenting data spatially on site
	6	Demonstration & presentation purposes (public meetings)
	2	Planning & analysis
	3	Reports
	2	Litigation
	2	Negotiations
	1	Evaluation of future data needs
	1	Error checking
Tabular	2	Review and summarizing result data
	1	Estimations of removal & reclamation Variables
	1	Reports
	1	Evaluation of future data needs
Other	1	Overheads for meetings, presentations

IV. Use of GIS

Questions	# Responses
1. Make requests, but have little or no involvement in the process.	1
2. Make requests and be involved as needed.	10
3. Make requests and take lead on project.	2
4. Become a hands on user by:*	5
Using the system at the State Library.	1
Using the system from your office (_2_) graphics terminal (_3_) P.C. with terminal emulation.	5

* Respondents were able to select multiple answers for this question. For example, one person selected the option to use the system from their office and oat the state library.

Specific objectives/goals the users hope to achieve by using the Clark Fork GIS are listed below:

...the easy and ready accessibility of data in a geographical perspective

Delineate areas of contamination

Identify areas where more data are needed

Better identify areas of contamination to aid in developing action alternatives for the Feasibility Studies

Provide an understanding of the groundwater and surface water relationships between Silver Bow Creek and the Butte Addition

Develop maps during the RI data collection to provide a better understanding of areal extent and trends in contamination, so that additional data collection can be efficiently designed

Determine waste volumes for possible removal alternatives and assess costs associated with removal actions

Possibly track PRP information

Make use of existing data in system

Speed up manipulation of data

Facilitate and expedite the compilation and presentation of site data.

Use to identify data needs.

Use data to help solve designated problems through modeling, statistics, etc.

Make planning exercises easier and more expeditious.

Support conclusions in a demonstrative fashion.

Communicate project findings and conclusions with PRPs, management and the public.

Gain a better perspective of hazardous substances at site.

Envision what the completely remedied site will look like.

Assist in presenting actual conditions and understanding proposed remedial actions.

Appendix L: EMSL-LV WORKPLAN

WORKPLAN FOR CLARK FORK RIVER GIS SUPPORT
Version 2.0
DRAFT

September 14, 1988

OBJECTIVES

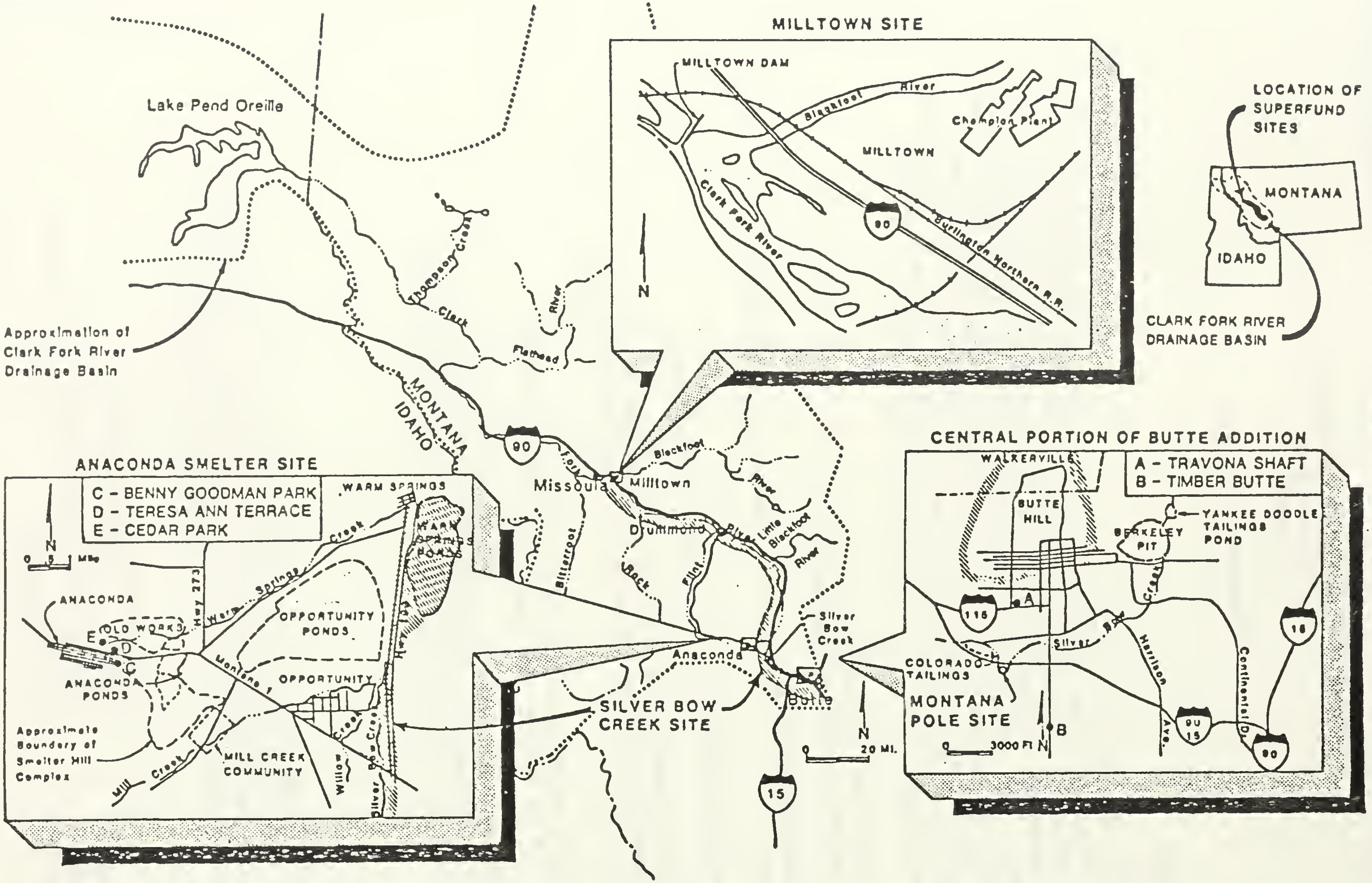
The overall objective of this effort is to develop a GIS database for the State of Montana for the management of NPL sites within the state. In building toward this objective, EMSL-LV will employ GIS and remote-sensing technology to acquire, organize and spatially relate features and sample data. The results of the GIS analyses will be used to assist Region VIII-EPA and the State of Montana with the Remedial Investigations (RI) and Feasibility Studies (FS) currently underway within the Upper Clark Fork River Basin. Toward that end, several sub-objectives have been established:

- Provide detailed mapping of the four NPL areas within the geographic extent of the study.
- Provide general mapping of the upper Clark Fork River Basin.
- Provide analysis of MSS and aerial photography.
- Collect, process and transfer to the State the data necessary to provide the products requested by project officers.
- Provide technical assistance to the State in their efforts to develop GIS expertise.
- Following the database development and transfer phase, provide ongoing operational support of the RI/FS process for each of the NPL sites.

APPROACH

The overall study area has been subdivided into four geographic areas; Butte, Silver Bow Creek, Anaconda, and Clark Fork River. The boundaries of these areas do not correspond directly with NPL site boundaries. The actual NPL sites are associated with the geographic study areas as follows:

NPL Site	Associated Geographic Area
Montana Pole	Butte
Silver Bow Creek	Butte, Silver Bow Creek,Clark Fork River
Anaconda Smelter	Anaconda
Milltown Reservoir	Clark Fork River



SUPERFUND SITES IN THE CLARK FORK RIVER BASIN

Figure 1

	Soil Contamination	Soil sample data	Region 8
	Urinary Arsenic	Sample data	Region 8
	Land use/Vegetation	Aircraft MSS/ photography	EMSL-LV EPIC **
		CH2M Hill maps	EMSL-LV **
		Satellite data	EMSL-LV **
CFR	Historic Irrigation	Aerial photography	EMSL-LV EPIC **
		CH2M Hill maps	EMSL-LV **
	Surface Water Quality	Sample data	Region 8
		Macrophytes	EMSL-LV ** EPIC **
		CH2M Hill maps	EMSL-LV **
	Fish	Sample data	Region 8
		EPA river reach	EMSL-LV
		Macrophytes	EMSL-LV ** EPIC **
		CH2M Hill maps	EMSL-LV **
	Water Purveyor Districts	Local maps	Region 8

METHOD

The GIS will be used to build and organize the environmental database for the Clark Fork River Basin. Thematic data layers, called coverages, will be added to the database by means of electronic transfer, digitizing, imagery analysis, and data entry. Coverages will be added according to the applicability to the short-term and long-term project objectives mentioned above.

The immediate focus of this project is to design and develop the databases necessary to assist Region VIII in the RI/FS processes for the Clark Fork River Study NPL sites. These databases have been identified within the geographic areas of concern and are listed above. A framework for creating and maintaining the Clark Fork GIS Database is described in the following sections. A summary of the source information and budgetary resources necessary to accomplish project tasks is detailed within the project framework.

Following the creation of the datasets necessary to support the RI/FS process, the task of providing operational support for the site-specific studies will be addressed. This task will require in input of those experts involved with the day-to-day operations of the site-specific RI/FS process. Initially, this input will be gleaned from the results of the 'User Needs Survey' conducted by the Montana State CFGIS staff. Using this information, the project site-officer will coordinate project personnel and provide direction to the GIS staff. GIS personnel will be responsible for working with the site officer, resource managers, site contractors, and other personnel in the design and implementation of those models that are appropriate to the particular task at hand.

Figure 1 shows the relationship among the NPL sites and the GIS study-area boundaries.

EMSL-LV will employ GIS and remote-sensing technology to assist the characterization of the upper Clark Fork River Basin. Because of the size of the combined study areas, the number of NPL sites, and the long list of necessary GIS products, it is proposed that an 'evolutional' approach be used to address this project. The project will begin in the Butte area and build outward both geographically and in the creation of the database. Input from the CFR Project Coordinator, project site-officers, EMSL-LV personnel and other project staff will be used to prioritize the tasks associated with each individual study and for the overall database development. Through a cohesive effort among the Technical Working Group, study-team members, and other project personnel; the project will be able to realize economies-of-scale for several of the data acquisition and processing tasks. This will reduce overall project personnel costs and processing time, allowing for an expedient RI/FS process. The following table describes products identified for each study area, the recommended input data source, and the party responsible for data acquisition. A change in the original scope-of-work is denoted by '**'.

DATA REQUIREMENTS AND RESPONSIBILITIES

Area	Product	Data Source	Responsible Party
Butte	Population/Land use/ Soil Contamination	Census	EMSL-LV
		Aerial photography	EMSL-LV EPIC **
		Soil sample data	Region 8
	Topography	USGS DEMs	EMSL-LV ** Region 8/ ARCO **
	Historic Facilities	Aerial photography	EMSL-LV EPIC **
Silver Bow	100-year Floodplain	FEMA maps	EMSL-LV
	Land use/Soil Contamination	Aerial photography	EMSL-LV EPIC **
		Soil sample data	Region 8
		Well logs	Region 8
	Surface Water Quality	Sample data	Region 8
	Macrophytes	Aerial photography	EMSL-LV ** EPIC **
	Stream Erosion/ Deposition	Aerial photography	EMSL-LV EPIC **
Anaconda	100-year Floodplain	FEMA maps	EMSL-LV
	Stream Erosion/ Deposition	Aerial photography	EMSL-LV EPIC **

CFR PROJECT DATABASE

The CFR Project Database will provide the State with the necessary workareas to conduct processing for each of the four NPL sites associated with the CFR Project. Each of the sites has a peculiar set of data needs required to satisfy project goals. As such, each site will require it's own workarea to maintain data sets, programs, and documentation. This will provide site officers, database administrators and processing staff with project-specific workarea within which to conduct their work. Additionally, it will provide project administrators with the ability to track costs associated with each site.

Prior to August 1988, costs incurred at EMSL-LV for the CFR Project were tracked without respect to specific sites. This was due to the study-area-wide nature of the work conducted during that time. Since August, separate workareas on the EMSL VAX computer have been established and an accounting system for project-specific costs has been installed. All work conducted by EMSL-LV will be tracked by the the NPL site with which the data are associated. Any costs incurred that are not directly attributable to a particular site or study will be split among the sites that receive that information.

The base cartographic structure will be provided by USGS 1:100,000 digital line graph (DLG) coverages. The DLG series have been compiled from 1:100,000-scale USGS maps and are available on a thematic basis. The USGS provides DLG data for a variety of themes, however only the transportation and hydrographic networks are available for the study area. These data have been acquired and processed for the Clark Fork Study area by EMSL-LV, and are available for use on the State's GIS.

This project-oriented database structure provides a convenient set of workareas making data transfer, tape backups, and project design easier than a single CFR workarea. Each of the project workareas will have sub-directories appropriate to the themes specific for that project. Additional sub-directories may include study-area boundaries, AML libraries, plot and map-composition libraries, etc. Any modelling tasks associated with a particular study will be conducted within that studies workarea.

The top-level directory may appear as follows:

```
                          CFRPRJ
                            |
                            |
          --------------------------------------------------
   |                |                    |              |
   |                |                    |              |
   |                |                    |              |
 BUTTE         SILVER BOW           ANACONDA       CLARK FORK
         CREEK                                RIVER
```

BUTTE ADDITION

The Butte Addittion NPL site will be the first study conducted using the State's GIS. Priority data sets were identified during project meetings held on May 18,19,20 1988 in Helena, Montana. Site Officer Russ Forba identified the following data needs, possible names for thematic workareas follow in parenthesis:

- Block-group Census data (CENSUS)
- Land-use data (LUSE)
- Soils-screening data (SOILS)
- Historic Facilities (HISTF)
- Topography (TOPO)

A possible workarea schema may appear as follows:

```
                              BUTTE
                                |
                                |
       --------------------------------------------------
       |        |          |          |         |         |
       |        |          |          |         |         |
     CENSUS    LUSE      HISTF      TOPO      SOILS     MAPS
```

These thematic workareas would carry the ARC/INFO coverages for the data associated with the Butte study. The MAPS subdirectory is a convenient workarea for plots and interactive-map-composition that may be produced. Other non-thematic workareas may be created as processing proceeds. The above mentioned themes are based upon the May meetings in Helena and do not necessarily represent the final database structure for the Butte study.

<u>Resource and Data Requirements: Current Status</u>
Original workplan: 14.5 man-weeks
Ammended workplan: 22.5 man-weeks

Population/CENSUS - 2.5 man-weeks

Census geography is not available in digital format and is scheduled to be digitized at EMSL-LV during September 1988. The 1:100,000 DLG Transportation coverage will form the initial topologic structure. An additional source map, the 1' = 1000' Census map provided by CDM, will be used to upgrade the transportation data. BLock-group census data has been acquired from Donnelley Marketing and has been incorporated into an INFO database. This data will be integrated with the census geography coverage to provide population data for Butte. 2.5 man-weeks have been allocated to finalize this task.

Land-use/LUSE - 3.0 man-weeks **6.0 man-weeks photo-interpretation of recent aerial photography, August 1987. In the original CFR Workplan (Version 1.3, 11/87), the interpreted data were to be transferred onto USGS basemaps and digitized. This task has been allocated 3.0 man-weeks to complete, subject to map availability.

Currently, only 1954 versions of 1:62,500-scale USGS maps are available for Butte, the availability of 1:24,000-scale map products for this area is questionable. If the 1:62,500-scale base maps prove to be unsuitable for data compilation, it may be appropriate to have the Environmental Photographic Interpretation Center (EPIC) use their analytical stereo plotter to digitally encode the interpreted data directly from the photography. This would negate the recompilation of the data onto paper maps. This would require a change in the scope of work. Cost estimates are found in the section on EPIC's role in CFR, and quality assurance procedures are forth coming.

Soils Contamination/SOILS - 1.0 man-week

The soils-screening survey data for 497 sample sites were acquired from Tom Haver, CDM-Denver. This data has been processed into an INFO database. The dataset contains toxic-contaminant levels for lead, arsenic, cadmium, and mercury. Sample data are available for three soil horizons; surface (0 - 1 inch), 1 - 12 inches, and 12 - 24 inches. An ARC/INFO coverage has been generated from this database and the attribute information has been associated with sample points.

The source map for the SOILS data was constructed by the Anaconda Mining Corporation (AMC) using a grid-reference system based upon an abitrary origin. The units of measure for this reference are feet. The SOILS coverage units for these data are AMC feet. A program to transform the AMC map coordinates to UTM meters is under development by EMSL-LV and should be available early in September 1988. Following the completion of this program, the SOILS database and the AMC-TO-UTM program will be made available to the State.

Topographic data/TOPO - 2.0 man-weeks **

The original workplan called for slope data to produced from the topographic mapping project that was to be conducted for the Butte/Silver-Bow area. This effort has been placed on hold for an undetermined amount of time.

A process is currently in use at EMSL-LV to generate topographic data using the ESRI's Triangulated Irregular Network (TIN) module. Elevation data is available in digital-elevation-model (DEM) form from the USGS, based upon 1:24,000 quadrangles and may be processed using TIN to create topographic surfaces. A ancillary product of this process is a slope coverage. It is estimated that for the Butte area (four 7.5-minute quads) this process would take approximately 2.0 man-weeks. Conversations with NCIC personnel confirm that the DEM data are available from the USGS (Norton, 1988). Acqusition of one of the DEM's would require 4-5 weeks longer than the other three due to quality control requirements. To acquire and process the DEM data would require a change in the scope of work from the original workplan.

Negotiations are currently underway between Region 8 - Montana and ARCO to acquire topographic data from large-scale aerial photography. This data would be highly resolute and may be required if the DEM data is deemed inappropriate for the studies to be conducted for the Butte site.

Historic Facilities/HISTF - 6.0 man-weeks **12.0 man-weeks

Historic mining and operations facilities will be produced from analysis of archival and current aerial photography. EMSL-LV has received achival aerial-photo indices for 1941, 1952, 1955, 1960, 1966, and 1980. 1976 photography is available through the USGS (Slonecker, 8/29/88). 1984 NHAP; 1983, 1986 and 1987 EPA photography is currently available in-house. These photographs will be visually interpreted and annotated for mining operation and facilities. These annotations will then be transferred to topographic map sheets and digitized. In addition to the historic facilities coverage, current mining facilities will be digitized from the 1" = 200' series of maps provided by CDM, Helena. The resultant structure of the HISTF directory could appear as follows:

```
                            HISTF
                              |
                              |
       -------------------------------------------------
       |        |          |        |         |        |
       |        |          |        |         |        |
     INFO    HF1952     HF1960   HF1966    HF1976   HF1987
```

It is anticipated that this task will require 4 man-weeks photo-interpretation and 2 man-weeks of GIS work.

As in the case of the Land-use data, only 1954 versions of 1:62,500-scale USGS maps are available for Butte. If the 1:62,500-scale base maps prove to be unsuitable for data compilation, it may be appropriate to have EPIC use their analytical stereo plotter to digitally encode the interpreted data directly from the photography. This would negate the recompilation of the data onto paper maps. This would require a change in the scope of work. Cost estimates are found in a section on the EPIC role in CFR, and quality assurance information are forth coming.

SILVER BOW CREEK

Project discussions for the Silver Bow Creek study were not held during the May meetings. As a result, the following proposed database reflects data needs as specified in the CFR Workplan Ver. 1.3 dated 11/23/87. The following data needs were identified, possible names for thematic workareas follow in parenthesis:

- 100-year floodplain (FLOODP)
- Land-use data (LUSE)
- Surface water quality (SURFWQ)
- Stream erosion/deposition (STMERO)
- Soils Contamination (SOILS)

A possible workarea schema may appear as follows:

```
                          SILVER BOW CREEK
                                 |
                                 |
      --------------------------------------------------
      |          |           |         |          |         |
      |          |           |         |          |         |
   FLOODP       LUSE       SURFWQ    STMERO      SOILS      MAPS
```

Resource and Data Requirements: Current Status

Original workplan: 9.5 man-weeks
Ammended workplan: 16.0 man-weeks

100-year Floodplain/FLODDP - 2.5 man-weeks

This task requires the use of FEMA FLood Insurance Program maps to identify the elevation of the 100-year floodplain. The FEMA maps have been acquired for all counties particular to the Clark Fork Project. These maps will be digitized following a significant amount of map preparation due to the varying scales of the source maps.

Land-use/LUSE - 2.0 man-weeks **5.0 man-weeks

Land-use data for the Silver Bow study will be acquired by means of photo-interpretation of recent aerial photography. Photography currently available at EMSL-LV for the Silver Bow Creek area includes; 1986 1:8,000; and 1987 1:18,000. In the original CFR Workplan (Version 1.3, 11/87), the interpreted data were to be transferred onto USGS basemaps and digitized. This task has been allocated 2.0 man-weeks to complete, subject to map availability.

Currently, only 1954 versions of 1:62,500-scale USGS maps are available for Silver Bow, and the availability of 1:24,000-scale map products for this area is questionable. If the 1:62,500-scale base maps prove to be unsuitable for data compilation, it may be appropriate to have EPIC use their analytical stereo-plotter to digitally encode the interpreted data directly from the photography. This would require a change in the scope of work. Cost estimates are found in a later section and quality-assurance parameters are forth coming.

Soils Contamination/SOILS - 1.0 man-week

Soils contamination data are to be provided to EMSL-LV in digital format by the Region. It is anticipated that one man-week will be required to process and check this data.

Well Data/WELLS - 1.0 man-week

Well data are to be provided to EMSL-LV in digital format by the Region. It is anticipated that one man-week will be required to process and check this data.

The well data will be combined with the soils-contamination and land-use data using overlay-analysis techniques to provide insight into the relationships among these data.

Surface Water Quality/SURFWQ - 1.0 man-week **3.0 man-weeks

Surface water-quality data are to be provided to EMSL-LV in digital format by the Region. It is anticipated that one man-week will be required to process and check this data.

As an indicator of surface-water quality, a macrophyte study may considered for the Silver Bow study. Low-altitude photography (October 1986, @1:8,000) available for this area may be interpreted for macrophytes by EMSL-LV photo-interpretation staff. This data would then be transferred to USGS basemaps for digitizing or sent to EPIC for direct digitizing from annotated photos. These activities would change the scope of work from the original workplan. Cost/time-frame estimates for a macrophyte study reveal an increase of approximately 2.0 man-weeks.

Stream Erosion and Deposition/STRMED - 2.0 man-weeks **3.5 man-weeks

Interpretation of aerial photographs will be used to detect areas of significant stream erosion and deposition. Low-altitude photos acquired from a mission flown in October 1986 will be used for this analysis. Photographic annotations will be transferred onto USGS basemaps and digitized. Alternatively, the use of EPIC's stereo-analytical plotter may be integrated into this process. EPIC's role would increase labor requirements by approximately 1.5 man-weeks.

ANACONDA

Project discussions for the Anaconda study were not held during the May meetings. As a result the following proposed database reflects data needs as specified in the CFR Workplan Ver. 1.3 dated 11/23/87. The following data needs were identified, possible names for thematic workareas follow in parenthesis:

- 100-year floodplain (FLOODP)
- Stream erosion/deposition (STMERO)
- Soil Contamination (SOILS)
- Urinary Arsenic (URINA)
- Land-use data (LUSE)
- Vegetation stress (VEG)

A possible workarea schema may appear as follows:

```
                           ANACONDA
                              |
                              |
     ---------------------------------------------------
     |         |          |         |         |         |
     |         |          |         |         |         |
   FLOODP    LUSE       URINA    STMERO     SOILS      VEG
```

Resource and Data Requirements: Current Status

Original workplan: 10.0 man-weeks
Ammended workplan: 17.5 man-weeks

100-year Floodplain/FLOODP - 2.0 man-weeks

This task requires the use of FEMA Flood Insurance Program maps to identify the elevation of the 100-year floodplain. The FEMA maps have been acquired for all counties particular to the Clark Fork Project. These maps will be digitized following a significant amount of map preparation due to the varying scales of the source maps.

Stream Erosion and Deposition/STRMEO - 2.5 man-weeks **5.0 man-weeks

Interpretation of aerial photographs will be used to detect areas of significant stream erosion and deposition. Low-altitude photos acquired from a mission flown in October 1986 will be used for this analysis. Photographic annotations will be transferred onto USGS basemaps and digitized. Alternatively, EPIC may be integrated into this process. EPIC's role would increase labor requirements by approximately 2.5 man-weeks.

Soils Contamination/SOILS - 1.0 man-week

Soils-contamination data are to be provided to EMSL-LV in digital with these data, sample points will be digitized from source maps. It is anticipated that one man-week will be required to process and check this data.

Urinary Arsenic/URINA - 1.5 man-weeks

Urinary-arsenic-sample data are to be provided to EMSL-LV in digital format by the Region. Using overlay-analysis techniques, these data will combined with the soils-contamination data in order to evaluate the relationships between these datasets. It is anticipated that 1.5 man-weeks will be required to process and check this data.

Land-use and Vegetation/LUSE and VEG - 3.0 man-weeks **8.0 man-weeks

Land-use/land-cover data for the Anaconda study will be acquired by means of photo-interpretation of recent aerial photography (August 1987 @1:18,000) and other source maps. In the original CFR Workplan (Version 1.3, 11/87), the interpreted data were to be transferred onto USGS basemaps and digitized. This task has been allocated 3.0 man-weeks to complete, subject to map availability.

Currently, only 1954 versions of 1:62,500-scale USGS maps are available for Anaconda, and the availability of 1:24,000-scale map products for this area is questionable. It may be appropriate to have EPIC use their analytical stereo-plotter to digitally encode the interpreted data directly from the photography. This would require a change in the scope of work. Cost estimates are found in a later section, and quality-assurance parameters are forth coming.

Following the photo analysis and subsequent digitizing effort, these data will be integrated with land-use data from the 1987 Clark Fork River Site Assessment study. This data has been acquired from CH2M Hill by EMSL-LV for use in Clark Fork Study. The CH2M Hill study includes information concerning land use, demography, irrigated lands, tailings, wells, and other data that may be pertinent to the Clark Fork Superfund sites.

The use of satellite imagery to identify landuse/land cover data may be an alternative to the photo interpretative effort mentioned above. Using remote-sensing techniques, these data can be used to identify landuse/land cover information for the Anacona study. This may prove to be a more efficient method for acquiring generalized land-use data for the Anaconda study. Additionally, areas of vegetative stress may be identified during the land-use mapping process. Once these stress areas are identified, they may be further studied using the more resolute aircraft multi-spectral scanner (MSS) data.

During acquisition of aerial photography for the study area, in August of 1987, MSS data, at 5-meter resolution, were accumulated at the same time. EMSL-LV staff have proposed to develop a hierarchical process in which areas of vegetative stress are initially flagged using the coarser satellite data, during the land-use mapping process. These flagged areas would then be investigated using the 5-meter MSS data to further refine the problem reduce processing time of the highly resolute MSS data by using the satellite imagery for the initial screening of the data.

CLARK FORK RIVER

Project discussions for the Clark Fork River study were not held during the May meetings. As a result the following proposed database reflects data needs as specified in the CFR Workplan Ver. 1.3 dated 11/23/87. The following data needs were identified, possible names for thematic workareas follow in parenthesis:

- Historic irrigation (HIRR)
- Surface water quality (SURFWQ)
- Fish data (FISH)
- Water Purveyor Districts (DIST)

A possible workarea schema may appear as follows:

```
                       CLARK FORK RIVER
                              |
                              |
          ----------------------------------------
          |            |              |          |
          |            |              |          |
        HIRRD       SURFWQ          FISH       DIST
```

<u>Resource and Data Requirements: Current Status</u>

Original workplan: 7.0 man-weeks
ammended workplan: 12.0 man-weeks

Historic/current irrigation/HIIRR - 4.0 man-weeks **

Historic irrigation will be derived from the interpretation of archival aerial photography. This information will be transferred into a digital format through either digitizing of data transposed to basemaps, or digitizing directly from annotated photography at EPIC. Additionally, the 1987 CH2M Hill study has information concerning historic irrigation within three time-frames; prior to 1955 and currently irrigated, after 1955 and currently irrigated, and historically irrigated but not currently irrigated. These data may augment the historic-photo analysis or negate it altogether. Additional time will be required to determine the usefullness of these source documents.

Surface Water Quality/SURFWQ - 1.0 man-week **6.0 man-weeks

Surface water-quality data are to be provided to EMSL-LV in digital format by the Region. It is anticipated that one man-week will be required to process and check this data.

As an indicator of surface-water quality, a macrophyte study may considered for the Clark Fork River study. Low-altitude photography (August 1983 @1:8,000) available for this area may be interpreted for macrophytes by EMSL-LV photo-interpretation staff. This data would then be transferred to USGS basemaps for digitizing tivities would change the scope of work from the original workplan. Cost/time-frame estimates for a macrophyte study reveal an increase of approximately 5.0 man-weeks.

An additional component of the surface-water quality study may be the CH2M Hill 'Tailings and Wells' map series conducted for the Clark Fork River Site Assessment in 1987. These data are found on a series of 10 1:24,000-scale blueline maps for the Clark Fork River from it's headwaters near Anaconda to Milltown Reservoir near Missoula. These maps contain information relating to tailings, metal-enriched soils, and well locations. Results of the June-July 1987 well-sample survey should be obtained as part of this effort. It is estimated that 3.0 man-weeks would be required to assemble this data into it's final form.

Fisheries/FISH - 2.0 man-weeks **

Fish data from the State of Montana Department of Fish, Wildlife and Parks survey conducted in 1987 will be obtained and digitally encoded. Data collected include: biomass, mark and recapture, density, and diversity.

EPA River Reach data is currently available at EMSL-LV. River Reach mileage and milepost data will be compared with similar data from the Montana River Reach dataset, and the 1:100,000-scale DLG Hydrography coverage to determine the relationships among them. If a consensus can be arrived at, survey and other data will be integrated with the chosen river-reach system.

Information contained in the CH2M Hill Clark Fork River Site Assessment study may be applicable to the fisheries investigation. In particular the Channel Gradient Profile, Sampling Locations & Geothermal Springs, and Tailings and Wells information may be useful. Input from site officers, fisheries biologists, and other resource personnel would be necessary to understand the relationships among these datasets. If these data are to be used, tabular attribures associated with the sample sites and well locations will have to be obtained.

Results of the macrophyte study, using August 1983 @1:8,000 aerial photography, may have bearing on the fisheries quality and may be incorporated into this study.

Water Purveyor Districts/DIST - 2.0 man-weeks

Water purveyor data is assumed to be available from local or state officials in the form of maps. These data can be digitized and assembled for the study area.

DATA QUALITY OBJECTIVES

Data quality objectives (DQO) refer to the level of uncertainty a decision-maker will accept from study results derived from environmental data. These are especially relevant when the results are going to be used in a regulatory or programmatic decision. Consideration must be given to defining the quality of the product required. Error in the results derived from the data must be controlled to achieve an acceptable level of confidence in the decision that will be made from that data. DQOs are developed using a top-down approach; the initial input and perspective of the decision-maker is critical to the successful development of DQOs. To be complete DQO standards must be accompanied by clear statements of:

* the decision to be made;
* why environmental data are needed and how they will be used;
* time and resource constraints on data collection;
* specifications regarding the domain of the decision;
* the calculations, statistical or otherwise, that will be performed on the data.

DQOs are designed primarily for data-collection programs, but they can have relevancy in data-archival systems like GIS. The GIS maintains information necessary to produce maps and other data upon which decisions will be made, therefore; the project site-officer must address the degree of uncertainty that is acceptable for that data.

The GIS does not collect data, but rather maintains a spatial framework for the data and is wholly dependent upon the quality of data that serves as input. Project site-officers must be ready to address the above statements, plus the following issues, in a statement appended to each database:

* What is the data source?
* What methods were used in collection?
* Was a statistically valid experimental design used?
* Was replication employed?
* How old is the data?

There is no right or wrong answer to these questions. but they must be answered in order for data to be considered for archival.

DQO standards for the cartographic accuracy of the data layers will be set by the EMSL-LV Project Officer. Cartographic accuracy requirements will be set at the same level as the USGS National Map Accuracy Standards. The 85 percentile has been established as the level of accuracy for all USGS products. In other words, 15% uncertainty is considered acceptable for catographic accuracy.

A GIS is not a static entity. This system will receive new data as time progresses and mechanisms will need to be formulated that will allow the archival of data that is relevant and meets the data quality objectives. GIS relevancy may be determined by reviewing the database design document. If data is related to the coverages in the database design, then it should be archived if it meets the DQO standards. Data not related to the scope of the coverages may not be archived. If a case can be made for its importance, new coverages may be created. New coverages will be created only by authorization of the CFR Project Coordinator and the EMSL-LV Project Officer.

All data archived in the system must meet DQO standards. Project Site Officers will be required to review all new data before initiating a request for GIS archival. After review, the data will be forwarded to EMSL-LV via the CFR Project Coordinator.

PROJECT MANAGEMENT

This is a dynamic project and all participants must realize that production must remain flexible in order to support the needs of the State of Montana and the project site-officers. However, multiple requests from numerous sources can be detrimental to project completion. Therefore, it is necessary that requests and needs be reviewed by the CFR Project Coordinator and the EMSL-LV Project Officer before any work is undertaken.

Region 8 Clark Fork River Project Coordinator: Bob Fox
EMSL-LV Project Officer: Mason Hewitt

TIME LINE

Given the need for the products listed above, tentative time lines must established based upon the proiorites developed diring the TWG meetings. Proposed times will be designed to indicate relative schedules and will need to remain flexible as the scope of work changes. Output products will be produced on the basis of priorities as determined by the CFR Project Coordinator and EMSL-LV Project Officer and also the availability of data required for the analyses.

The project will be reviewed periodically for progress and and changes in direction.

COST ACCOUNTING

A review of costs incurred to date will be performed on a monthly basis and will be provided to the CFR Project Coordinator.

THE EPIC ROLE IN CFR

The Environmental Photographic Interpretation Center (EPIC) located in Warrentin, Virginia. This laboratory provides photogrammetric expertise and photographic interpreation for EPA's regions and other laboratorys.

EPIC has developed processes which enables aerial photography to be digitally encoded during the photo-interpretation session. This removes the step of transferring interpreted or annotated data from the photography to basemaps prior to digitizing. The removal of the data-transfer step reduces the potential for error in both the photo-to-basemap transfer and the subsequent digitizing effort.

The following cost estimates have been generated by Terry Slonecker, EPIC, for a variety of the tasks identified in previous sections. Although not every task has been addressed here, the level of effort for similar tasks should be roughly equivalent.

TASK	TIME	COSTS
BUTTE LAND USE	4-8 MAN WEEKS	4300 - 8600

One year: additional years should involve only change detection and would be approximately 20-25% of the original effort/year)

HISTORICAL FACILITIES MAP	3-4 MAN WEEKS	2500 - 3500

One year: two weeks P.I. (mid-level) and one - two weeks mapping (senior). Additional years should follow the same general formula as above.

DIGITIZE PREVIOUSLY ANNOTATED PHOTOS	4-6 MAN HOURS PER STEREO MODEL	110 - 160/MODEL

This is based on my experience with Old Southington where we input a typical EMSL_LV photo interpretation report. The type of mapping you're talking about would seem to me to be maybe less 'busy' in terms of lines/nodes/polygons per model so that this estimate may be slightly high.

LAND USE ANACONDA	5-6 MAN WEEKS	5500 - 6600

This is a tough one. I think about 2.5 to 3 days per quad should do it since this area appears to be alot less busy than the butte area.)

Both the land use estimates assume that the first effort will be at least 70% NHAP. Also, please remember that the land use deliverables will be essentially 24K based roads and hydrography updated with the specialized land uses that were outlined by Gregg Monger.

REFERENCES

Norton, William. USGS Rocky Mountain Information Center, Denver, Co., personnel conversation, September 8, 1988.

CLARK FORK DATA MANAGEMENT SYSTEM

Records per table by survey May 1989

	TABLE										TOTAL
SURVEY	CFRST	CFRWEL	CFRSA	CFRMET	CFRCFO	CFRCPO	CFRSPO	CFRICO	CFRAIR	CFRSGO	RECORDS
AMC AI01	4	-	-	-	-	-	-	-	1382	-	1386
AMC AI02	3	-	-	-	-	-	-	-	378	-	381
AMC AL01	22	-	262	-	-	-	260	58	-	56	658
AMC AR01	10	-	19	-	2	19	-	19	-	-	69
AMC GW01	60	-	-	-	2202	-	-	-	-	-	2262
AMC GW02	70	-	108	-	128	108	-	107	-	-	521
AMC HE01	22	-	22	-	-	-	22	22	-	22	110
AMC ME01	1	-	-	20597	-	-	-	-	-	-	20598
AMC OW01	30	-	68	-	2	3	64	60	-	35	262
AMC SE01	11	-	11	-	-	11	-	22	-	-	55
AMC SO01	17	-	62	-	-	-	51	118	-	41	289
AMC SO02	6	-	13	-	-	-	13	39	-	12	83
AMC SW01	27	-	86	-	-	48	-	122	-	28	311
AMC TA01	25	-	263	-	-	-	257	243	-	225	1013
ANS UA01	103	-	233	-	-	-	-	263	-	-	599 *
ANS SO03	57	-	134	-	-	-	112	134	-	-	437
SBC GW01	169	167	209	-	501	207	-	188	-	-	1441
SBC SD01	5	-	14	-	-	-	-	-	-	-	19 *
SBC SW01	79	-	695	-	806	797	-	1351	-	-	3728
# OBSERV	721	167	2199	20597	3641	1193	779	2746	1760	419	34222

* Incomplete

CFRST	Stations
CFRWEL	Wells
CFRSA	Samples
CFRMET	Meteorological Obbservations
CFRCFO	Field Observations
CFRCPO	Conventional Water
CFRSPO	Conventional Solids
CFRICO	Inorganic Chemicals
CFRAIR	Air Inorganics
CFRSGO	Solids Grain Size

Appendix M: CURRENT DATA IN THE CLARK FORK GIS

Tic Locations: Corner points of USGS 1:100,000 quads
UTM Coordinates, Y-shift of -5 million

Tic Locations: Corner points of USGS 1:24,000 quads
UTM Coordinates, Y-shift of -5 million

USGS Digital Line Graph and Geographic Names Data:

All of the 1:100,000 Digital Line Graph coverages in the GIS were digitized by the U.S. Geological Survey from 1:100,000 scale USGS and Bureau of Land Management maps. These maps are based on USGS 1:24,000 and 1:62,500 scale maps dated from 1950 to 1968. The Geographic Names coverages are based on the 1982 release of the USGS Geographic Names Information System. This data consists of one point location for every named feature on USGS maps plus names from decisions of the U.S. Board of Geographic Names.

The Clark Fork study area is divided into seven different regions corresponding to seven USGS 1:100,000 scale map sheets. There are five coverages for each region. The themes of these coverages are:

Hydrography
Roads and Trails
Railroads
Miscellaneous Transportation (Pipelines, Powerlines, etc.)
Geographic Names

The seven regions are:

Butte North
Butte South
Phillipsburg
Elliston (West Half)
Wisdom (East Half)
Missoula East
Missoula West (East Half)

Statewide Townships

Contains the boundaries of Montana's townships. The polygon attribute table contains 4 items, TOWN, N-S, RANGE, and E-W, which identify the townships. This data was digitized from 1:250,00 scale maps during the 1970s. Many of the township corners are over 300 meters away from where we believe they should actually be.

County Boundaries

Contains the boundaries of Montana's counties. This data was digitized in the 1970s from 1:250,000 scale maps. The polygon attribute table contains an item, NAME, which identifies each county.

Clark Fork Major Streams

Contains all the major streams extracted from the seven USGS 1:100,000 scale DLG hydrography coverages and combined into one coverage.

Clark Fork Major Roads

Contains all the major roads extracted from the seven USGS 1:100,000 scale DLG road coverages and combined into one coverage.

Clark Fork Irrigation 1

Contains the boundaries of land irrigated from the Clark Fork River, digitized from CH2M-Hill 1987 1:62.500 scale site assessment maps. This data extends approximately from Milltown to Warm Springs. A one-digit item in the polygon attribute table called IRR is 1 if the land was irrigated prior to 1955 or 1959 according to county records, and still is being irrigated according to 1983 aerial photography. IRR is 2 if the areas have been irrigated since 1955 or 1959 according to the aerial photos or water rights claims at DNRC, and 3 if the areas were formerly but not currently irrigated.

Clark Fork Irrigation 2

Contains the boundaries of all irrigated lands shown on CH2M-Hill 1:62,500 scale land use and demography maps dated 1987. This data extends approximately from Milltown to Warm Springs.

Clark Fork River 1

Contains arcs extracted from USGS 1:100,000 scale Digital Line Graphs representing the Clark Fork and Silver Bow Creek. All attribute codes are the same as those in the DLGs.

Clark Fork River 2

The Clark Fork as a polygon. Digitized from CH2M-Hill site assessment maps. This data allows the left and right banks to be identified as well as providing a larger scale, more accurate representation of the river.

Clark Fork Wells

Streamside wells digitized from CH2M-Hill site assessment maps--sample data related to the wells is not yet available.

Clark Fork Tailings

Streamside tailings digitized from the CH2M-Hill site assessment maps.

Waste Sites

Boundaries of 31 regions in the Blackfoot and Upper Clark Fork basins which have been identified for ARCO as potential sites for the disposal of tailings. These sites are the "first cut", having been chosen according to loose guidelines on surface slope and population density only. These sites were digitized from 1:100,000 scale maps by GIS project personnel, based on legal descriptions provided by an ARCO contractor.

Heritage Sites

Locations and description of 165 Natural Heritage Program Element Occurrencesin the Blackfoot and Upper Clark Fork basins. Element occurrences represent biological species or communities which are rare or endangered in Montana.

Butte North Historic Preservation Sites

State Historic Preservation data for Butte, Anaconda, and a buffer area along the Clark Fork River.

Butte North Sections

Contains the boundaries of townships and sections in the west half of the Butte North 1:100,000 scale quad. The arc attribute table contains an item, TLINE, which equals 'Y' if the arc is a township line. The polygon attribute table contains three items, TOWN, SECTION, and RANGE, which identify the sections. This data was digitized from USGS 1:24,000 and 1:62,500 scale maps in 1988.

Butte North River Reach

This is an INFO file which contains Montana Rivers Study data for streams in the Butte North 1:100,000 scale USGS quadrangle. The file can be linked to the Butte North Digital Line Graph to create map displays of the data.

Butte Land Use

Land use for Butte interpreted and digitized from 1987 aerial photography by the EPA Environmental Photographic Interpretation Center.

Butte Roads

Butte roads digitized from 1987 aerial photography by the EPA Environmental Photographic Interpretation Center.

Coordinate System; LOCID, a 6-digit character identifier, and several 13-digit decimal items (type N) giving Arsenic (AS), Cadmium (CD), Lead (PB), and Mercury (HG) concentrations at three different depths (A = 0-1", B = 1-12", C = 12-24"). These item names are AS__A, CD__A, HG__A, PB__A, AS__B, etc.

Butte Soil Samples 2

Soil sample locations digitized from CDM blueline maps. These locations can be related to the data in SAMPLES-G by using LOCID as the relate item.

Montana Pole

The boundary of the Montana Pole Superfund site, from CDM blueline maps.

Anaconda Soil Data

Environemtal survey data and soil samples from three different surveys in the Anaconda area.

Butte Railroads

Butte railroads digitized from 1987 aerial photography by the EPA Environmental Photographic Interpretation Center.

Butte Census Geography

Contains the boundaries of 1108 Census Blocks in Butte, excluding Walkerville. These were digitized from 1:14,000 scale Census maps. Two items exist in the polygon attribute table - TRACT, a 6-digit census tract identifier, and BG/ED, a 7-character block identifier. Both of these items are required to uniquely identify a census block.

Butte Census Groups

Contains boundaries and census data for 65 Census Groups in Butte. The group boundaries are a subset of the arcs from CGEOG. Each Group is uniquely identified in the polygon attribute table by the 7-digit item TR/GR. The 6-digit item TRACT identifies the Census Tract the group falls in. This coverage's attribute table contains several items of population data, all are 9-digit integers:

HH-88 - Estimated number of households, 1988
HH-93 - Projected number of households, 1993
POP-80 - Population, 1980
POP-88 - Estimated population, 1988
POP-93 - Projected population, 1993
M/0-5/88 - Number of males, 0-5 years old, 1988

Demographic data items exist for males and females, for 1988 and 1993. The other age groups are: 6-13, 14-17, 18-24, 25-29, 30-34, 35-44, 45-54, 55-64, and 65+.

Butte Census Tracts

Contains the boundaries of Butte's 8 census tracts and is a subset of the CGEOG coverage. There is a 6-digit item called TRACT in the attribute table for each census tract.

Butte Priority Soils

Contains the boudaries of 38 Phase I and 2 Phase II priority soils regions, digitized at the State Library from a CDM 1:12,000 scale map.

Butte Geology

Contains surficial geologic units digitized at the State Library from a 1:12,000 scale Anaconda Company map.

Butte Dumps

The boundaries of 210 waste rock dumps and reclaimed areas digitized from 1:2,400 scale blueline reproductions of maps from CDM. A two-character item called TYPE uses 'WD' for waste rock dumps and 'RC' for reclaimed areas.

Butte Mill Sites

Contains the boundaries of 21 mill sites, smelters, and ore concentrators digitized from CDM 1:2,400 scale blueline maps. A two-character item called TYPE uses 'M' for mill sites, 'S' for smelters, and 'CN' for ore concentrator sites.

Butte Pit

Contains the boundaries of 5 open pit mines, from CDM blueline maps.

Butte Schools

Contains the boundaries of 68 schoolyards and play areas digitized from CDM blueline maps. A two-character item called TYPE in the polygon attribute table uses 'SC' for schools and 'PA' for play areas.

Butte Mine Shafts

Contains point locations for 322 mine shafts, digitized from CDM blueline maps.

Butte Soil Samples 1

The locations of soil sample locations converted from CDM data. Items in the PAT include X_COORD and Y_COORD, which are 8-digit decimal coordinates (type N) in the Anaconda

CLARK FORK DATA MANAGEMENT SYSTEM

Directory of Surveys as of May 1989

SURVEY: AMC AI01 Anaconda Air Quality Monitoring
LOCATION: Stations in Mill Creek, Johnson's Curve, Lincoln School
START/END: / /84 / /86

SURVEY: AMC AI02 State of Montana Air Quality Monitoring around Anaconda
LOCATION: Stations in Lincoln School, and Highway Junction
START/END: / /86 / /86

SURVEY: AMC AL01 Anaconda Alluvium Master Investigation
LOCATION: Alluvium samples from under old tailings & downstream from ponds
START/END: 02/07/85 03/15/85

SURVEY: AMC AR01 Anaconda Arbiter Master Investigation
LOCATION: Anaconda Arbiter site
START/END: 02/15/85 05/16/85

SURVEY: AMC GW01 Historic Groundwater samples for 1973 to Oct 1980
LOCATION: Anaconda Reduction Works
START/END: 02/22/73 10/30/82

SURVEY: AMC GW02 Anaconda Groundwater Master Investigation
LOCATION: Anaconda
START/END: / /85 / /85

SURVEY: AMC HE01 Anaconda Health Effects Soils Investigation
LOCATION: Towns of Anaconda, Opportunity, Mill Creek, Warm Springs
START/END: 12/01/84 01/31/85

SURVEY: AMC ME01 Anaconda Meteorology Monitoring
LOCATION: Johnson's Curve Monitoring Station
START/END: / /84 / /86

SURVEY: AMC OW01 Anaconda Old Works Master Investigation
LOCATION: AMC Old Works site, NE of town of Anaconda
START/END: 03/01/85 06/01/85

SURVEY: AMC SE01 Storm Event, 4/29/86 -
LOCATION: Towns of Anaconda, Mill Creek, and Warm Springs
START/END: 04/29/86 04/29/86

SURVEY: AMC SO01 Anaconda Soils Master Investigation
LOCATION: Deer Lodge Valley
START/END: / /85 / /85

SURVEY: AMC SO02 Anaconda Soils Investigation Phase II
LOCATION: Transect between Mill Creek and Crackerville
START/END: 09/01/85 10/31/85

SURVEY: AMC SW01 First Surface Water Survey
LOCATION:
START/END: 04/ /85 10/ /85

SURVEY: AMC TA01 Anaconda Tailings Master Investigation
LOCATION: Tailings from Anaconda and Opportunity tailings ponds
START/END: 02/06/85 03/30/85

SURVEY: ANS S003 Anaconda Community Soils Screening Study
LOCATION: Homes in Anaconda, Opportunity, Warm Springs, Galen,
START/END: 08/31/87 09/24/87

SURVEY: ANS UA01 Urinary Arsenic Study
LOCATION: Homes in Anaconda and Opportunity, MT
START/END: 03/ /85 03/ /85

SURVEY: SBC GW01 Silver Bow Creek CERCLA RI ground water quality data
LOCATION: Silver Bow Creek
START/END: 01/ /85 01/ /86

SURVEY: SBC SD01 Silver Bow Creek CERCLA RI Warm Springs Ponds Bottom Sediments
LOCATION: Warm Springs Ponds
START/END: 03/28/85 05/08/85

SURVEY: SBC SE01 Silver Bow Creek CERCLA RI seepage water quality data
LOCATION: Silver Bow Creek
START/END: 06/ /85 07/ /85

SURVEY: SBC SW01 Silver Bow Creek CERCLA RI surface water quality data
LOCATION: Silver Bow Creek
START/END: 12/ /84 08/ /85

Appendix O: CCJM DATA VALIDATION STANDARD OPERATING PROCEDURE FOR INORGANICS

DOCUMENT UNDERGOING REVISION

The CCJM Data Validation Standard Operating Procedure for Inorganics will be inserted here when released in final format.

Appendix P: CCJM DATA VALIDATION WORKPLAN

APPENDIX A

DATA VALIDATION

The data validation reviews of analytical data from the Anaconda Smelter Site will be performed according to procedures and requirements established and adopted by the EPA, and to the accuracy and precision criteria outlined in the EPA Control Laboratory Program (CLP) Statement of Work (SOW) 784 for analysis of chemical data. EPA-approved data reviewers will assess the degree to which the analytical data meet the QC criteria by following guidelines defined in the CLP Standard Operation Procedure (SOP) documents for data validation. These procedures specify the analytical data and support documentation needed and the technical criteria required to validate the data. The criteria are described below.

- Precision. This criterion measures the reproducibility of a measurement. Precision may also be reported relative to some measurement of dispersion such as standard deviation.
- Accuracy. The degree of agreement of a measurement (or an average of measurements of the same parameter), X, with an accepted reference or true value, T. This is usually expressed as the difference between two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of bias in a system.
- Representativeness. In a laboratory setting, this criterion is usually evaluated according to the data's credibility, based on the QC officer's past experience with similar samples.
- Correctness of analytical data. This criterion is simply a check on all mathematical calculations, data transposition, units of measure, and significant figures.
- Completeness of analytical data. This criterion is expressed as a checklist of the quality control documentation and data obtained from the measurement system (instrumentation or other measuring device) compared with the CLP - required criteria.

Relative accuracy is measured during the data validation process as a percent recovery for a spiked sample for inorganic analyses. Matrix spikes and analytical spikes are used to evaluate the inorganic data for accuracy. Matrix spikes are actual samples spiked with a representative group of hazardous substances list (HSL) compounds. One sample in each set of samples, for each matrix, for every twenty samples or once each day, (whichever is the more frequent) is required to be split for matrix spike analysis. This grouping is termed a "batch".

Precision is measured during the data validation process as the relative percent difference between analytical results for two aliquots (duplicates) of the same sample. The analysis of a sample/sample duplicate QC pair is also required for every "batch" of samples. Completeness and correctness also include checking documentation and calculations for instrument calibration and correction factors, internal standards, blanks, percent solids (for soils). See Table A-1 for inorganic Completeness Checklists.

The purpose of the CCJM Anaconda project data validation review is to ensure that rigorous laboratory analytical quality control criteria have been met and that data meet the project specific quality control criteria. The EPA Region 8 Summary of Inorganic Data Quality Assurance Review (hereafter referred to as Data Validation Report) generated by the reviewer itemizes and explains all QC criteria as defined in the SOW and addresses laboratory performance and contractual compliance.

The CLP QC criteria are not always completely met. The CLP SOP guidelines define "qualifiers", i.e., designated letter codes, to be added to the analytical results which define the limitations of the data in terms of "estimated" and "rejected" values. These qualifiers are listed in Table A-2 for Inorganic Analyses. This table has been modified by CCJM from the CLP SOP and has been approved by EPA Region VIII. Appendix C defines the use of the computerized database to track and sort data using the "qualifier" criteria.

The Data Validation Narrative Summary report prepared by CCJM (as an option) expands on the Data by summarizing in "non-chemistry" language, the content and implications of the Data Validation report. This summary is prepared specifically and at the request of the data users, e.g., project manager(s), and addresses recommendations for interpreting the data qualifications. Recommendations are provided regarding qualifications applied, biases associated with qualification, or rejection of data.

A complete CLP data validation review requires submission from the laboratory of all chain-of-custody information, all quality control data, sample data, calibration, methodology and procedural information, proper report forms, and all raw (and/or instrument) data. See Tables A-1 for the QC Completeness Checklists for Inorganic Analyses.

TABLE A-1

RAS Inorganic Data Completeness Checklist

______ Inorganic Cover Page

______ Inorganic analysis data sheets (Form I)

______ Initial calibration and calibration verification results (Form II)

______ Continuing calibration verification (Form II)

______ Blank results (Form III)

______ ICP interference check sample (Form IV)

______ Spike results (Form V)

______ Duplicate results (Form VI)

______ Instrument Detection limits (Form VII)

______ Laboratory Control Sample (LCS) Results (Form VII)

______ Serial Dilution Results

______ Raw data for samples

______ Raw data for calibration standards

______ Raw data for blanks

______ Raw data for ICP quality control (ICS and Serial Dilution)

______ Raw data for spikes

______ Raw data for duplicates

______ Raw data for LCS

______ Raw data for furnace AA

______ Raw data for mercury analysis

______ Raw data for cyanide analysis

______ Percent solids calculation - soils only

______ Sample prep/digestion logs

______ Traffic Reports

______ Method References

Definition of Qualifiers
(Used by Data Reviewer)

(R) or (Rej) = Rejected ('R' used by laboratory indicates matrix spike recovery problems)

(UJ) = Undetected but reported detection limit is estimated

(J) = Estimated

The following qualifiers give further detail of the type and amount of qualification a given data point has received.

-H = Qualified due to holding time violation

-E = Qualified due to interference problems (ICP serial dilution or poor analytical spike recovery by graphite furnace)

-I = Qualified due to exceeding ICP linear range

-* = Qualified due to duplicate control limits being exceeded

-S = Qualified due to matrix spike recoveries outside control limits

-C = Qualified due to instrument calibration problems

-L = Qualified due to LCS recoveries outside control limits

-B = Qualified due to blank contamination problems

Example: The percent recovery of the Aluminum matrix spike was only 65%. Undetected values (e.g., Al 200u) will be flagged as follows:

Al 200u (UJ-S)

Meaning the reported detection limit (200u) is estimated (UJ) due to spike recovery problems (-S).

Reported positive Aluminum values (e.g., Al 250) will be flagged as follows:

Al 250 (J-S)

Meaning the reported positive result (250) is estimated (J) due to spike recovery problems (-S).

Form I A

U. S. EPA Contract Laboratory Program
Sample Management Office
P.O. Box 818 - Alexandria, VA 22313
703/557-2490 FTS: 8-557-2490

EPA Sample No.

Date: 03/17/88

INORGANIC ANALYSIS DATA SHEET

LAB NAME: Cambridge Analyt. Assoc.
SOW NO.: 785
LAB SAMPLE ID. NO.: 8803066-01

CASE NO.
Lab Receipt Date ~~03/05/88~~ 2 5 ar 2/5
QC REPORT NO. 8803066

Elements Identified and Measured

Concentration: Low ____X____ Medium ________
Matrix: Water ___X___ Soil ________ Sludge ________ Other ________

ug/L

1	Aluminum	55U	P	13	Magnesium	75U	P
2	Antimony	59U	P	14	Manganese	4.0U	P
3	Arsenic	3.0U	JS,50	15	Mercury	0.20U	CV
4	Barium	[2.5]	P	16	Nickel	20U	P
5	Beryllium	1.00U	P	17	Potassium	250U	P
6	Cadmium	4.8U	P	18	Selenium	2.00u	JS,00E ar
7	Calcium	[219]	P	19	Silver	7.0U	P
8	Chromium	8.0U	P	20	Sodium	[354]E	P
9	Cobalt	25U	P	21	Thallium	4.0U	F
10	Copper	10U	P	22	Vanadium	20U	P
11	Iron	[44]	P	23	Zinc	23	P
12	Lead	3.0U	JS,90	24			
Cyanide		10U	C	Percent solids (%)			

Footnotes: For reporting results to EPA. standard result qualifiers are us
as defined on Cover Page. Additional flags or footnotes explaini
results are encouraged. Definition of such flags must be explic
and contained on Cover Page. however.

Comments: Sample description is colorless. clear with ~~a oH of 1~~ no artifacts. ar

5/5/88

Lab Manager Edna Epelm

APPENDIX B

The "Level A/B" Evaluations on analytical data and supporting documentation from the Anaconda Smelter site will be performed with reference to the criteria established and adopted by Region VIII EPA in the document titled "Evaluation Criteria for Existing Data from CERCLA Study Areas" January 5, 1985.

EPA approved data reviewers assess the degree to which the data and documentation meet the evaluation requirements. The "Level A/B" evaluations track the complete submittal of the documentation listed in Table B-1. The sources of the items listed in Table B-1 include field notebooks, project planning documents, chain-of-custody forms, laboratory notebooks and laboratory analytical data packages.

The level A/B Evaluation Reports will list any "Level A/B" data quality criteria for which adequate, acceptable, and appropriate documentation has not been included in the data packages submitted to CCJM by Tetra Tech.

Recognition of Problem

A3. Sampling location within the required tolerances for the study;

A4. Physical description of sampling location (e.g., tilled, rangeland, type of crop, monitoring well type, portion of plant sampled, etc.);

A11. Laboratory analysis methods including reference method;

A13. Companion sampling effort such as crops or livestock (yes or no; if yes, then what);

A14. Visual classification of sample using an accepted classification system (if applicable).

D6. A comprehensive evaluation of all factors indicates data was prescreened by any party using different criteria than that contained herein (bias screening); and

D7. Sample site selection criteria provide representativeness.

- Determining a Level of Action

Custody and Document Control

C1. Field custody noted in field logbook or transfer of custody documentation available;

C2. Samples hand delivered to laboratory or transfer-of-custody documentation available;

C3. Laboratory custody documented by transfer-of-custody documentation from either field personnel or shipper;

C4. Laboratory custody documented through designated laboratory sample custodian with secured sample storage area;

C5. Sample designation number(s) traceable through entire monitoring system;

C6. Field notebooks and all custody documents stored in secure repository or under the control of a document custodian;

C7. All forms filled out completely in indelible ink without alterations except as initialed; and

C8. Identity of sample taker.

Field Sampling

A1. Sampling date;

A2. Sampling team and/or member in charge;

A5. Sampling depth increment for soils (if applicable);

A6. Sample collection technique;

A7. Field preparation techniques (e.g., sieving, compositing, etc.);

A8. Sample preservation technique(s);

A9. Sampling shipping data and laboratory analysis date;

B8. Analysis of field replicates (duplicates or splits) at a frequency of at least 1 per 20 samples for each matrix;

D3. Sample storage within suitable temperature, light, and moisture conditions;

D5. Proper sample collection equipment used (i.e., inert); properly decontaminated; not biased;

Lab QC

A11. Laboratory method including reference method: and

A12. Laboratory analysis detection limits either by specific notation or through reference method.

B1. Documentation of laboratory/field instrumentation and standardization and methods (other than a reference);

B3. Procedural reference and/or calibration data;

B4. Verification of standards using EPA or NBS reference materials not less than one each three months;

B5. Analysis of laboratory (reagent) blanks at a frequency of at least 1 per 20 samples;

B6. Analysis of laboratory replicates (duplicate and splits) at a frequency of at least 1 per 20 samples;

B7. Analysis of laboratory spikes at a frequency of at least 1 per 20 samples if the analyte is amenable to spiking; for instance, there is not method for spiking pH;

B9. Presentation of tabulated QC data or QC charts/acceptance criteria;

B10. QA/QC certification of the laboratory and/or participation in round-robin testing by and/or with EPA-accredited agencies;

D1. Compatibility between field and laboratory measurements or suitable explanation of discrepancy; and

Lab Prep

A10. Laboratory preparation techniques (e.g., grinding, sieving, drying, digestion);

B2. Sample bottle preparation;

D3. Sample storage within suitable temperature, light, and moisture conditions; and

D4. Proper sample containers used (i.e., inert).

D2. Analysis within time limits suitable for the preservation and analysis methods used.

Screening and auxiliary analysis that might enhance study

APPENDIX C
Computerized Database

The analytical data for each sample in the Phase I database have been entered by Tetra Tech into a computerized database using the KNOWLEDGE MAN software program. The computerized data for each sample include:

Laboratory performing the analysis
EPA sample number
Tetra Tech sample number
Parameters (elements) analyzed and concentrations detected
Sample matrix (e.g., soil or water)
Date of analysis
Date of sample collection
(See attachment)

The analytical data can be sorted or categorized using any of these items listed above. For example, a list could be generated of all soil samples collected in June 1985 and analyzed for arsenic.

The software development included in this work plan will be implemented in order to expand the sorting and comparing of data within the database. The database is being expanded to include the "qualifiers" defined in Appendix A.* Samples could be listed for example as:

- All samples with arsenic concentrations less than 1 mg/kg and that have no arsenic qualifiers added

- or all lead data for the June 1985 sampling which have matrix spike qualifiers less than 50%.

The sorting by qualifiers will allow the EPA RPM to categorize data for report preparation and to maximize utilization of the project results. Samples can quickly be listed, for example, by concentration levels detected in all or specific samples. Samples can be categorized by quality of the data as defined by the data qualifiers in conjunction with proposed uses of the data or Data Quality Objectives (DQOs).

* These "qualifiers" will include information on 1) The type of qualification - undetected (U), estimated (J) or rejected (R); 2) the reason for qualification (See Table A-2); 3) and, where applicable, the value of the qualifier: e.g., a spike recovery equal to 50% would be identified in the database as JS, 50. Multiple qualifiers can be tracked. Data entry will be performed by CCJM personnel after the data validation reviews have been performed and data "qualifiers" have been reported.

Table C-1 is an example of an analytical report sheet prepared for input into the expanded computer database. The data qualifiers would be interpreted as:

EPA Sample #1 data:

1) for arsenic was qualified as "estimated" JS, 50 for matrix spike recovery of 50%;
2) for lead was qualified as "estimated" J*, 40 for a duplicate relative percent difference (RPD) of 40;
3) for selenium was qualified as "rejected" RS, 0 for matrix spike recovery of 0%;
4) and for thallium and vanadium was flagged as "undetected", U.

All unqualified data should be considered to be "valid" as defined by the EPA project-specific quality control criteria and CLP SOP guidelines.